APPENDIX IX

Regional Modeling Analyses

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Introduction

The MATES III regional modeling analysis is presented in Chapter 4 of the main document. This Appendix provides the analyses to compliment and support the regional modeling demonstration. These include: characterization and validation of the meteorological input data, development of the MATES III modeling emissions inventory, discussion of the development of the boundary conditions, model performance, and risk.

Background

MATES III uses the Comprehensive Air Quality Model with Extensions (CAMx) enhanced with a reactive tracer modeling capability (RTRAC) [Environ, provided the dispersion modeling platform and chemistry used to simulate annual impacts of both gaseous and aerosol toxic compounds in the Basin]. The version of the RTRAC "probing tool" in CAMx used in the modeling simulations includes an air toxics chemistry module that is used to treat the formation and destruction of reactive air toxic compounds.

In the 2000 MATES II analysis, the Urban Airshed Model with TOX (UAMTOX) chemistry was used to simulate the advection and accumulation of toxic compound emissions throughout the Basin. UAMTOX was simulated for a slightly protracted two squared kilometer grid domain that overlaid the basin. The analysis relies on the 1997-98 emissions projection from the 1997 AQMP and meteorological data fields for 1997-98 generated from objective analysis using a diagnostic wind model. At this time, these tools were consistent with those used in both the 1997 and 2003 AQMP attainment demonstrations.

Peer review of the 2003 AQMP modeling strongly suggested that future AQMP attainment demonstrations utilize more state-of-the-sciences tools that utilize updated chemistry modules, improved dispersion algorithms and mass consistent meteorological data. The recommendations were placed in action for the 2007 AQMP where the dispersion platform moved from UAM to CAMx and the diagnostic wind meteorological model was replace by MM5 prognostic model. CAMx coupled with MM5 input using the "one atmosphere" gaseous and particulate chemistry was used to simulate both episodic ozone and annual concentrations so $PM_{2.5}$.

The original plan for MATES III was to replicate the analysis conducted for the 1998-99 field program using the UAMTOX model and diagnostic meteorological model. The theory was to enable a true apples-to-apples comparison of the current and previous modeling analyses. The plan was modified prior to adoption of the 2007 AQMP to take into account the advances in annual particulate modeling that was conducted as part of the 2007 $PM_{2.5}$ attainment demonstration. Given the extensive effort in the 2007 AQMP to simulate particulates, using the peer recommended state-of-the-science art modeling tools, it was decided that a better comparison linking the AQMP $PM_{2.5}$ projections to the base year toxics analysis would be more complementary and up-to-date. As such, the MATES III simulations were conducted using the CAMx – MM5 couple with the RTRAC chemistry.

CAMx Modeling Domain

Modeling was conducted on a domain that encompassed the South Coast Air Basin and the coastal shipping lanes located in the Southern California Bite portions of the Basin using a grid size of two squared kilometers. (Figure IX-1 depicts the MATES III modeling domain. The shaded portion of the grid area represents the extension of the domain beyond that used for MATES II). Concentrations simulated for a specific location in the domain consisted of nine-cell distance weighted average.

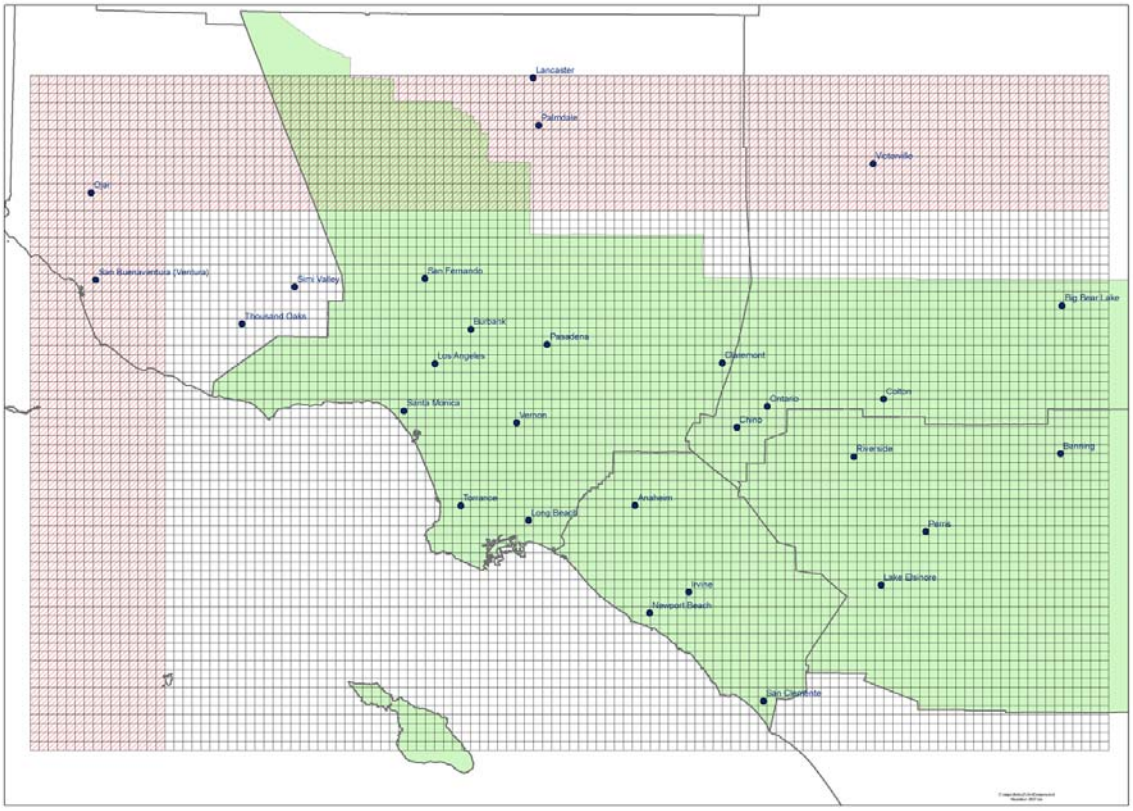

Figure X-1

MATES III Modeling Domain
(Shaded area highlights the grid extension to the MATES II modeling domain)

Development of Meteorological Fields

The Penn State/National Center for Atmospheric Research Mesoscale Model 5 (MM5) was employed to produce meteorological fields for the MATES III CAMx regional modeling analyses.

MATES III air monitoring spanned a three year calendar period from April 2004 through March of 2006. The regional toxic modeling analysis was conducted for data sampled during the one-year period including January 1, through December 31, 2005.

Meteorological Outlook of Year 2005

The beginning of year 2005 was characterized as anomalously above-average precipitation in the southern California. A pronounced split-flow configuration was evident over western North America, with one branch of the westerlies entering the continent over northern British Columbia and the other entering over the Baja Peninsula. These conditions were associated with a southward shift of the main jet stream and storm track across the western United States, which resulted in significantly above-average precipitation in the Southern California, Southwest and the western inter-mountain regions of the U.S. Southern California experienced above-average precipitation during the period of October 2004 to May 2005. During summer months – July and August, 500 hectopascal (hPa) geopotential heights were above-average level over the western U.S., which lead to well above-average temperatures in the area, which was situated beneath a very persistent upper-level ridge. Fall and winter months returned close to climatology when North America generally experienced below-average precipitation in the west and above-average rainfall in the southeastern U.S.

When comparing the meteorology between 2005 to the MATES II monitoring period of April 1998-March 1999, two issues stand out: the MATES II period was drier than MATES III but over the course of the period experienced less stagnation. Using a statistical analysis developed for the 1997 AQMP that evaluates pollution dispersion potential based on the presence and strength of temperature inversions, 2005 was very close to average despite having greater rainfall than 1998-99. Using the same measure, 1998-1999 was slightly above average for dispersion potential but experienced a milder winter with less storm activity. This is borne out through Basin statistics of measurable rainfall where 2005 experienced a greater frequency of days having measurable rainfall in Downtown Los Angeles by 30 percent (43 verses 33 days) and total rainfall measured at USC by 182 percent (26.0 verses 14.1 inches). The additional rainfall may have suppressed the amount of re-entrained or fugitive dust that contributes to concentration measurements of EC.

Numerical Model Configuration

The MM5 terrain following computational domain spans 254 km X 164 km in the east-west and north-south directions, respectively. The MM5 domain overlaps the CAMx domain by two additional rows and columns in each lateral boundary. Figure IV-2 depicts the grid specific terrain file used in the MM5 simulation.

Four Dimensional Data Assimilation (FDDA) was conducted by utilizing National Weather Service (NWS) twice-daily sounding data and hourly surface measurements taken within the domain. Each simulation was conducted for a 6-day period with the first 24 hours of spin up period. The detailed configuration and physical options used in the MM5 simulation are given in Table IV-1.

Table IV-1

MM5 configuration

Component	Option
Number of grids	(127 X 82) in east-west and north-south respectively
Number of vertical layers	29 layers with the lowest layer being approximately at 20 m agl.
Initial and Boundary values	ETA 218 grid (12 km grid distance) analysis field
Boundary Layer scheme	Blackadar
Soil model	Five-layer soil model
Cumulus parameterization	Explicit
Micro physics	Simple ice
Radiation	Cloud radiation
Four Dimensional Data Analysis	Analysis nudging with NWS surface and upper air measurements

Meteorological Model Performance

The MM5 performance was extensively evaluated using NWS surface measurements and Enivron's METSTAT statistical software to computes mean, bias, gross error, root mean square error (RMSE), and index of agreement.

Figure IX-3 shows the time series of hourly observed and predicted temperature at 2 m above ground level (agl) for September 2005. The model successfully resolved overall

cooling and warming trend induced by synoptic scale motions, while daily maximum and minimum temperatures were slightly over and under predicted, respectively. This can be partly attributed to inaccurate representation of surface characteristics such as soil moisture content and land use category.

In all, the model has less than 2 degrees of bias and gross error and approximately 2 degrees of RMSE, which are approximately equivalent to MM5 performance for 2007 air quality management plan (AQMP) modeling case (Figure IX-4). Wind speed turned out to be under-predicted by less than 1 m s^{-1}. In general, all conventional surface parameters including wind speed, direction, temperature and water vapor mixing ratio showed good agreement with the observations (Figures IX-5 and IX-6).

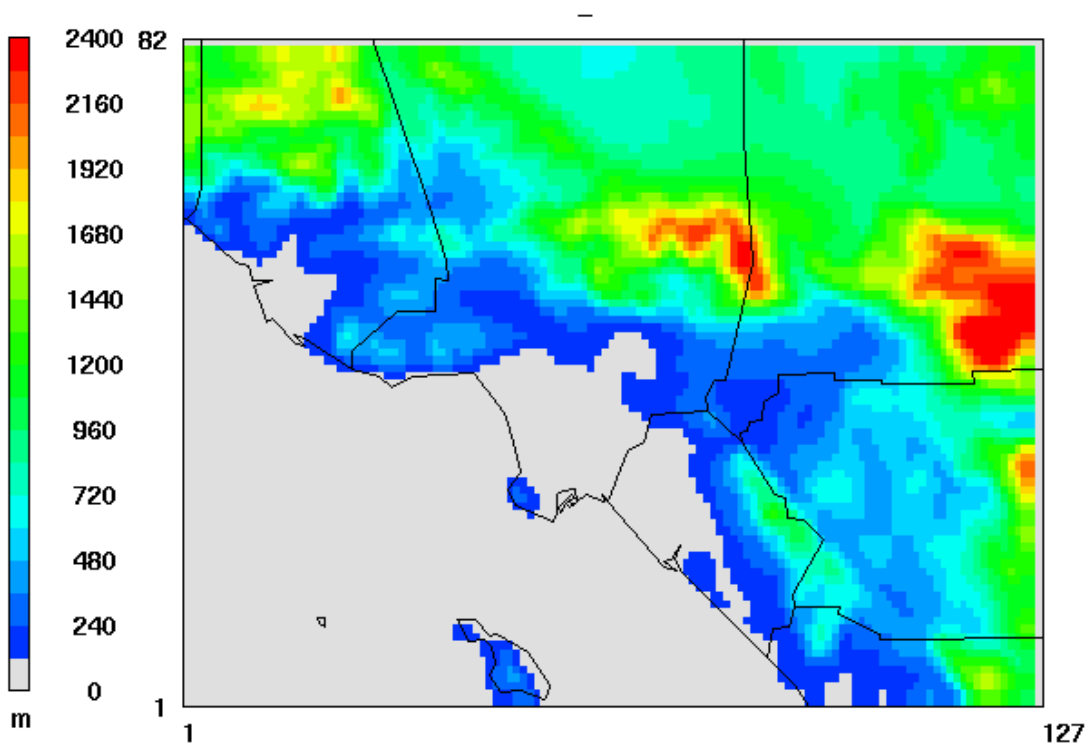

Figure IX-2

The topography and the county boundaries of the MM5 computational domain

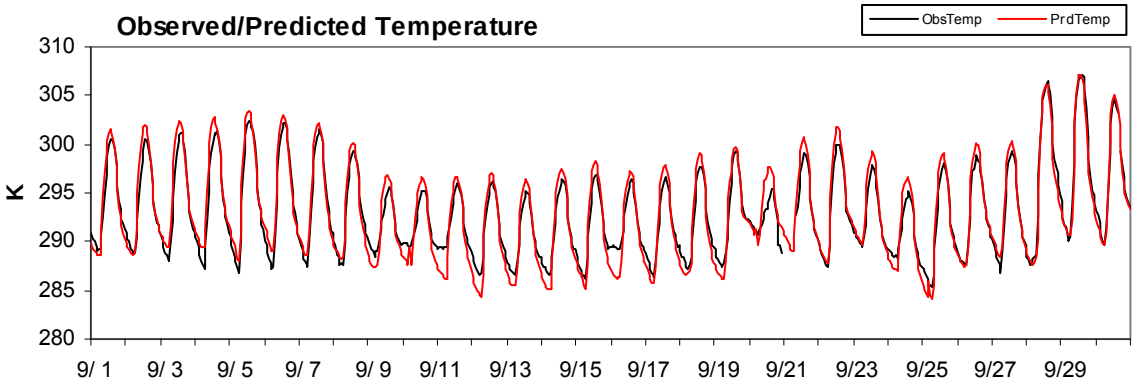

FIGURE IX-3

. Time series of observed and predicted temperature at 2 m above ground level for September, 2005. The data are hourly average observations of all available measurements within the domain and the corresponding predictions.

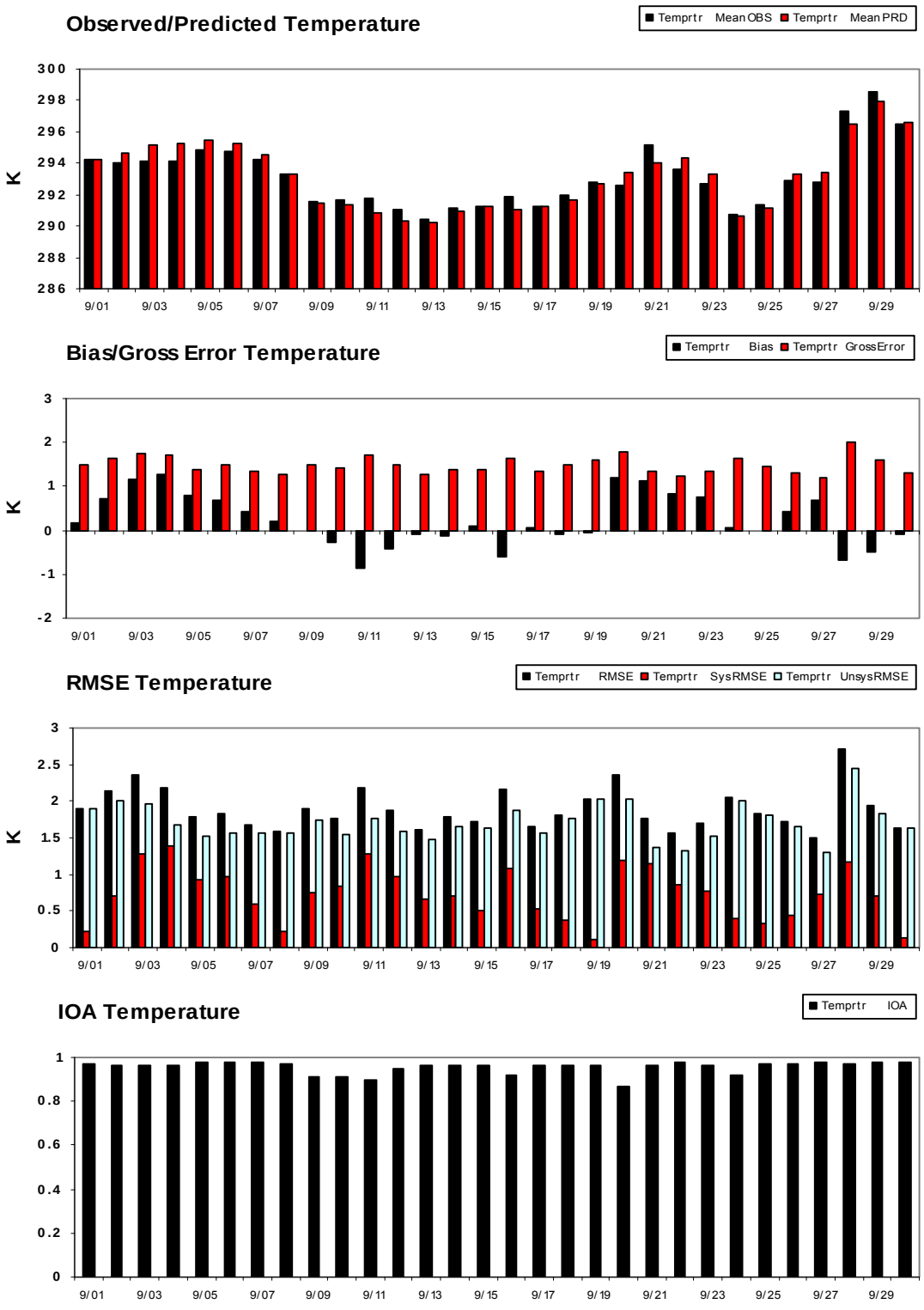

Figure IX-4

Daily averaged (a) mean, (b) bias and gross error, (c) root mean square error, and (d) index of agreement for observed and predicted temperature at 2 m agl.

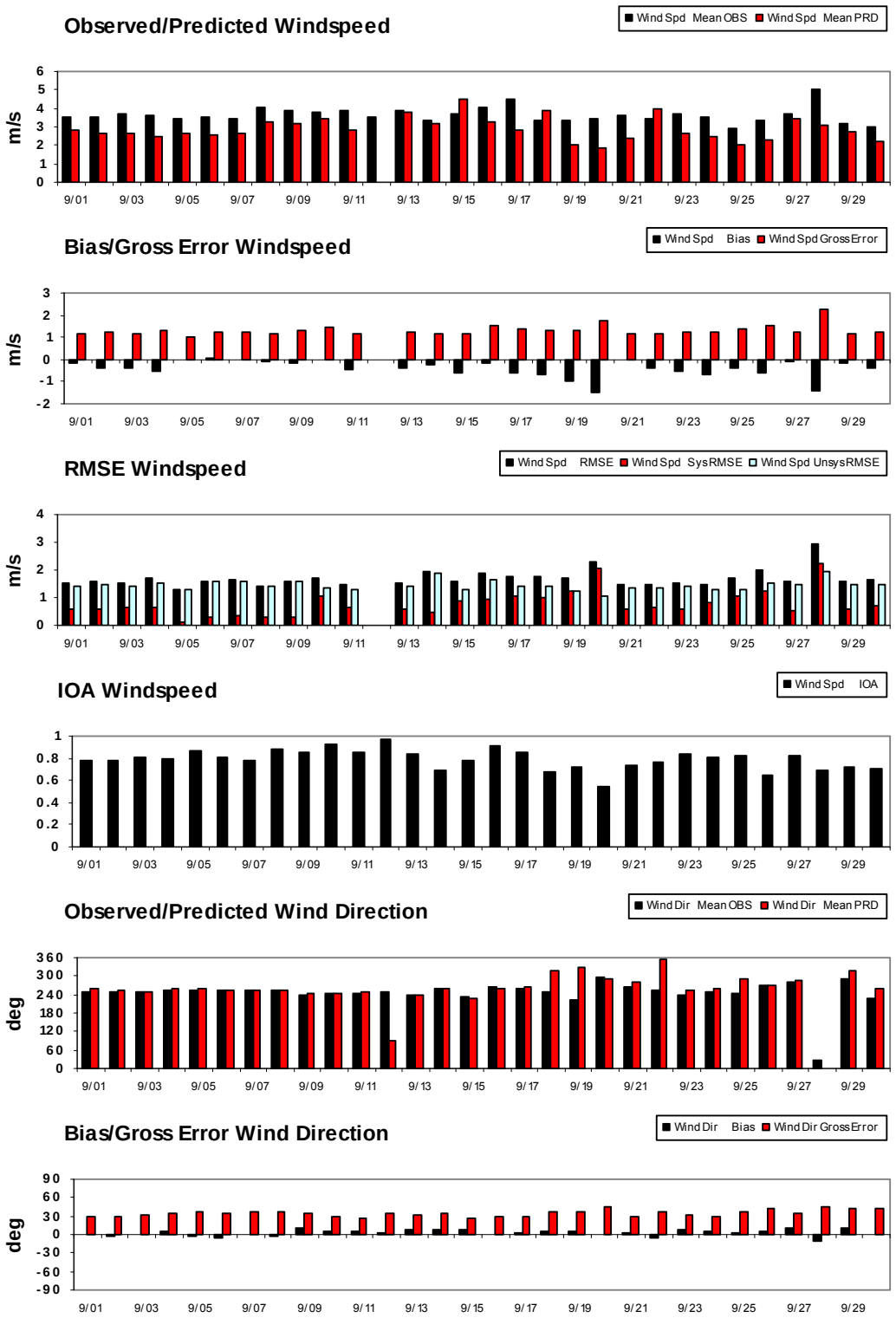

Figure IX-5.

Daily averaged (a) mean, (b) bias and gross error, (c) root mean square error, and (d) index of agreement for observed and predicted wind speed. (e) Mean and (f) bias and gross error of wind direction are presented as well.

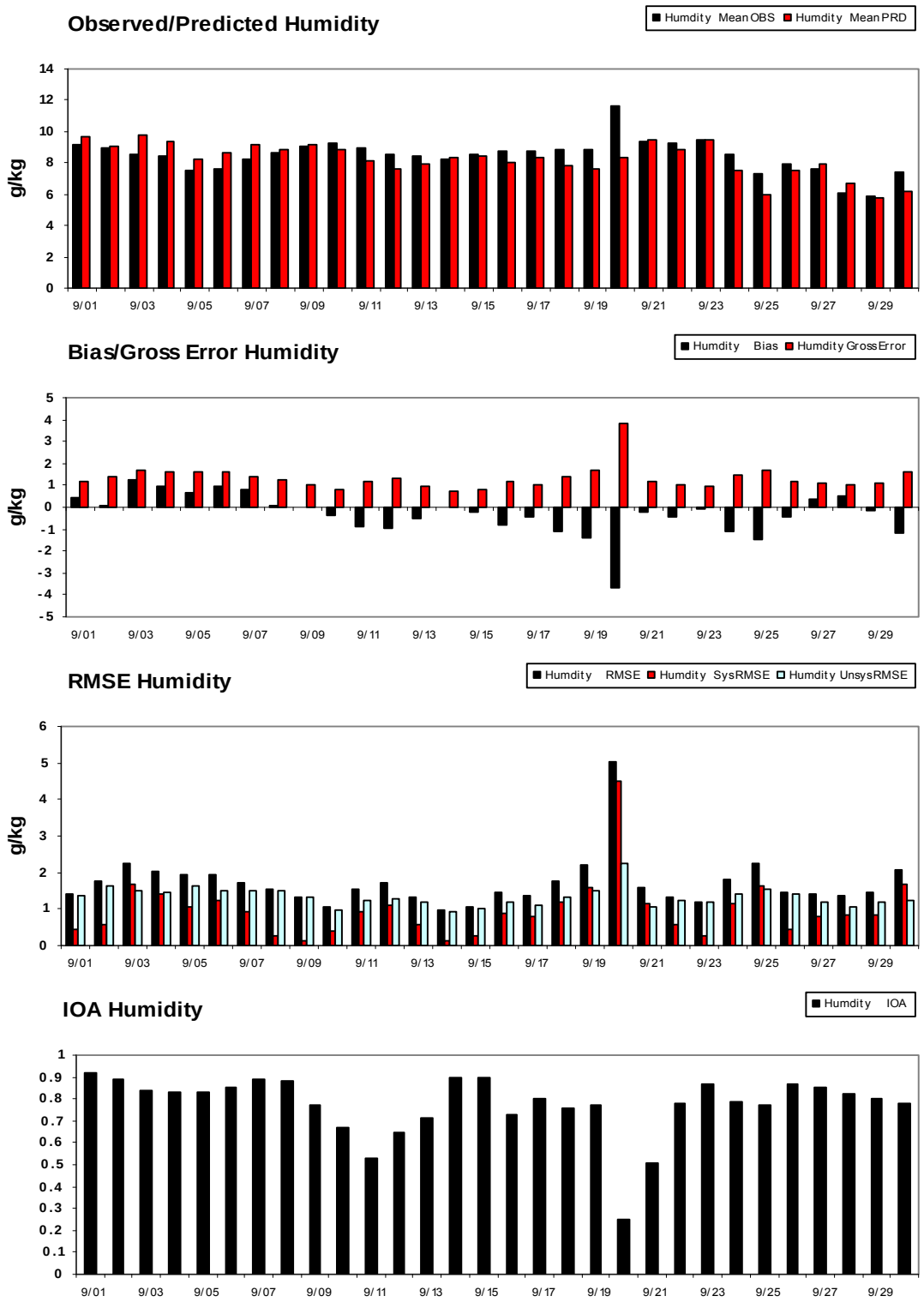

Figure IX-6.

Daily averaged (a) mean, (b) bias and gross error, (c) root mean square error, and (d) index of agreement for observed and predicted wind speed. (e) Mean and (f) bias and gross error of wind direction are presented as well.

MATES III Modeling Emissions

An updated version of the 2007 AQMP emissions inventory for model year 2005, which included detailed source profiles of AB2588 air toxic sources, provided mobile and stationary source input for the MATES III CAMx/RTRAC simulations. Mobile source emissions were adjusted for time-of-day and day-of-week travel patterns based on CalTrans weigh in motion data profiles. Table IX-2 lists the weekday daily diesel emissions projected for 2005 and back-cast for 1998. (A comprehensive breakdown of the planning VOC, NOx, CO, SO_2 and particulate emissions for 2005 used in the MATES III simulation is provided in Chapter 3 and Appendix III of the 2007 AQMP). Table IX-2 also includes the MATES II TSP diesel emissions for 1998 for comparison.

A comparison of the MATES III (2007 AQMP) 2005 projection of the weekday $PM_{2.5}$ diesel emissions shows a 4.8 percent reduction in emissions from the back-cast for 1998. The most significant area of diesel particulate matter emissions growth occurs in the shipping categories associated with goods movement. MATES III back-casts of the weekday 1998 TSP diesel inventory using the 2007 AQMP inventory were almost 21 percent higher than the corresponding MATES II values.

Figures IX-7a through IX-7u provides the grid based weekday modeling emissions for selected toxic pollutant and precursor emissions categories.

Table IX-2

MATES III Diesel/EC Modeling Emissions (TPD)

Compound	MATES –III				MATES II	
	2005		1998 (Back-cast)		1998	
	$PM_{2.5}$	TSP	$PM_{2.5}$	TSP	$PM_{2.5}$	TSP
Total Diesel	26.06	28.33	27.37	29.75	N/A	23.56
EC	15.17	20	15.46	20.71	N/A	25.87
DPM						
On-road	9.52	10.35	10.81	11.35	N/A	19.95
Off-road	11.02	11.97	12.29	11.36	N/A	8.08
Ships	4.15	4.51	2.7	2.93	N/A	2.59
Trains	0.86	0.94	0.79	0.86	N/A	0.53
Stationary	0.51	0.55	0.78	0.85	N/A	0.41

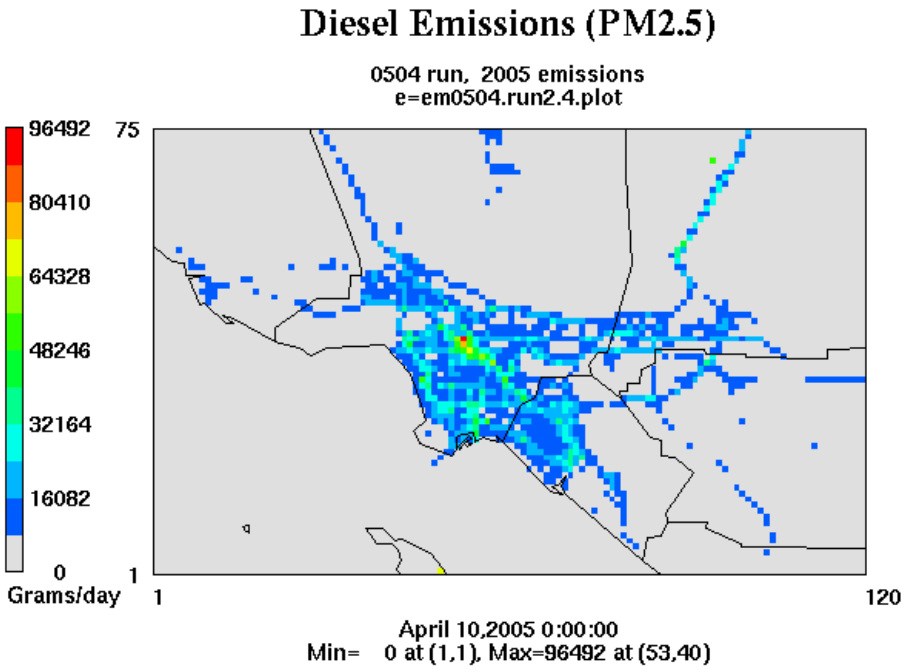

FIGURE IX-7a
Weekday average emissions pattern for Total Diesel $PM_{2.5}$

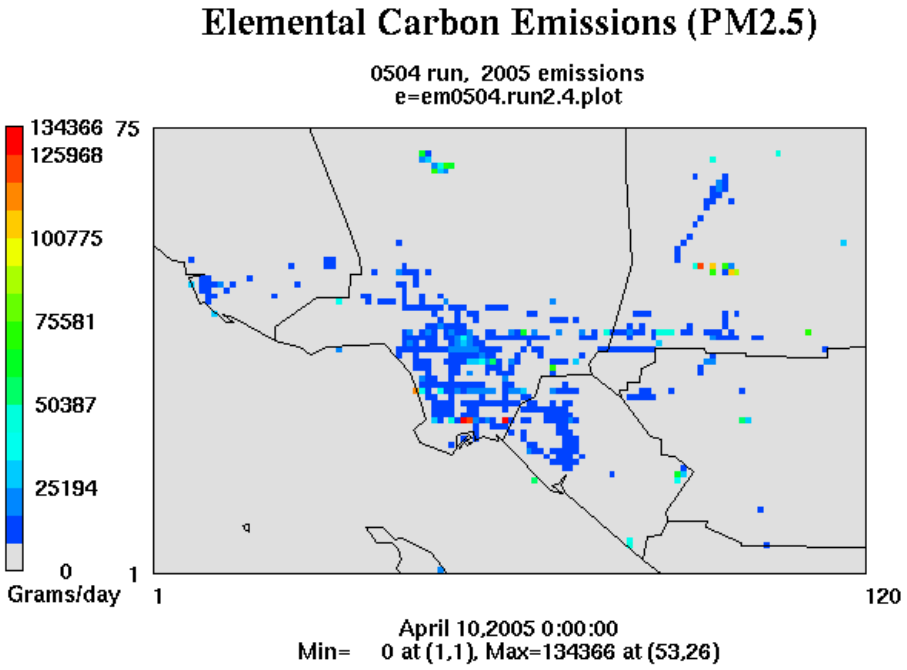

FIGURE IX-7b
Weekday average emissions pattern for Elemental Carbon

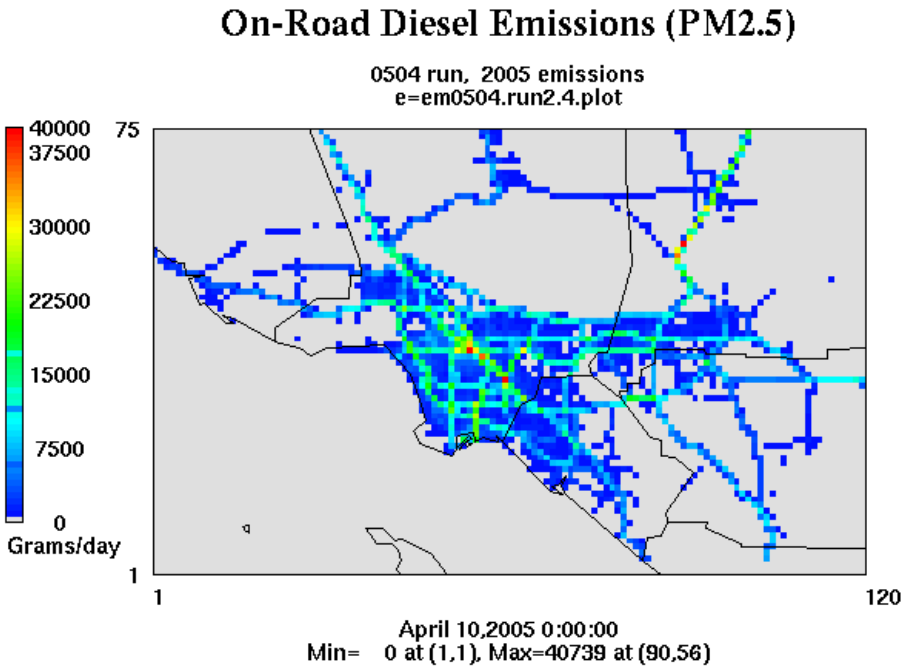

FIGURE IX-7c
Weekday average emissions pattern for On-Road Diesel $PM_{2.5}$

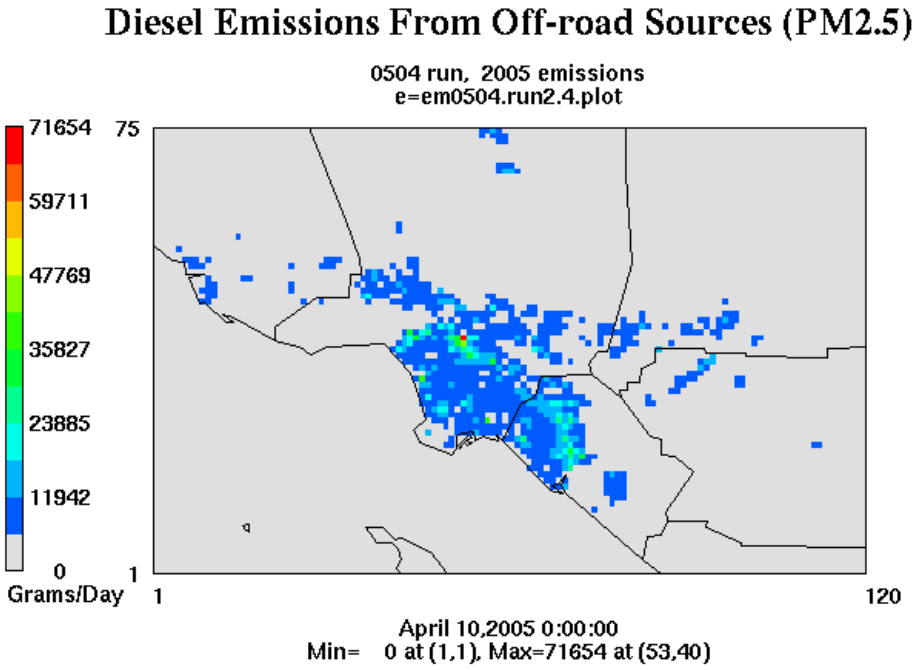

FIGURE IX-7d
Weekday average emissions pattern for Off-Road Diesel $PM_{2.5}$

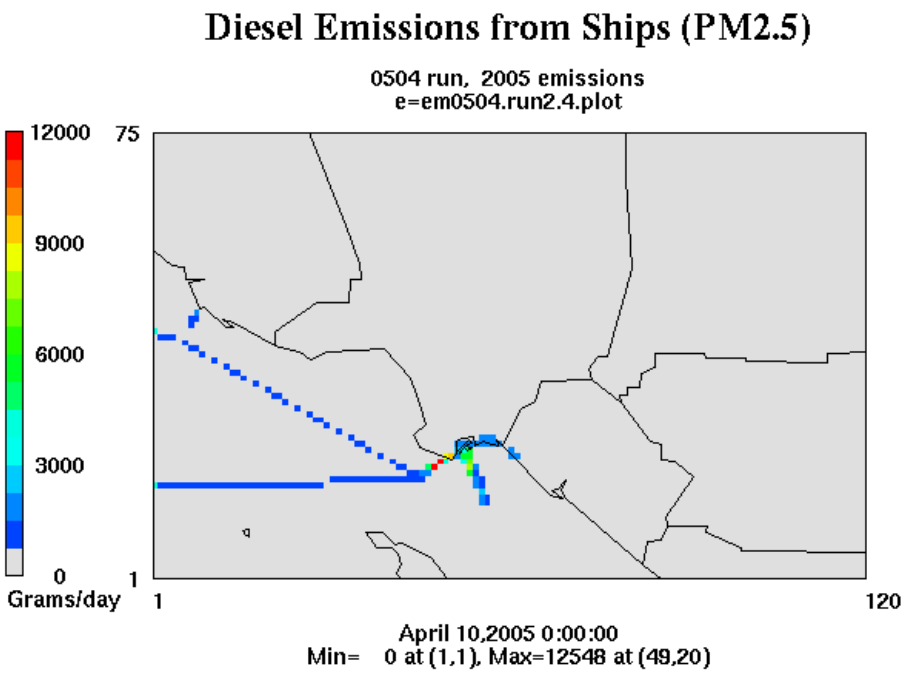

FIGURE IX-7e
Weekday average emissions pattern Diesel $PM_{2.5}$ from Ships

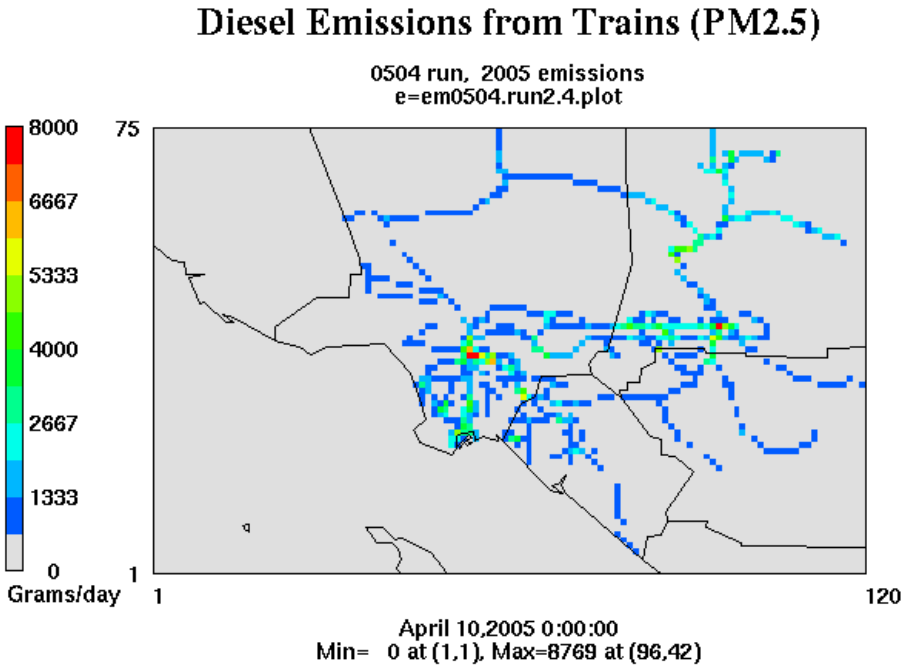

FIGURE IX-7f
Weekday average emissions pattern Diesel $PM_{2.5}$ from Trains

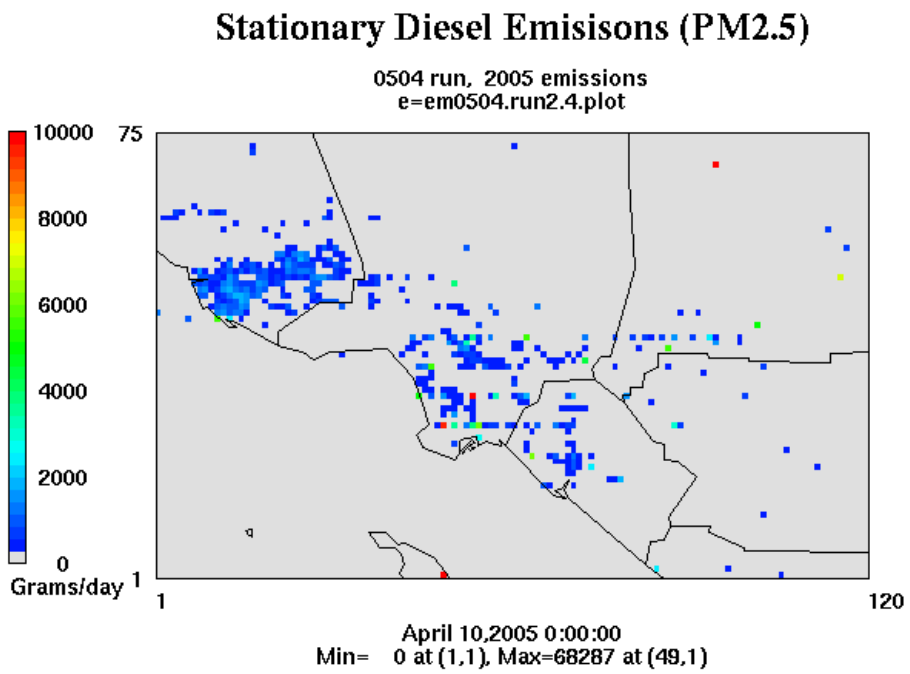

FIGURE IX-7g
Weekday average emissions pattern Diesel $PM_{2.5}$ from Stationary Sources

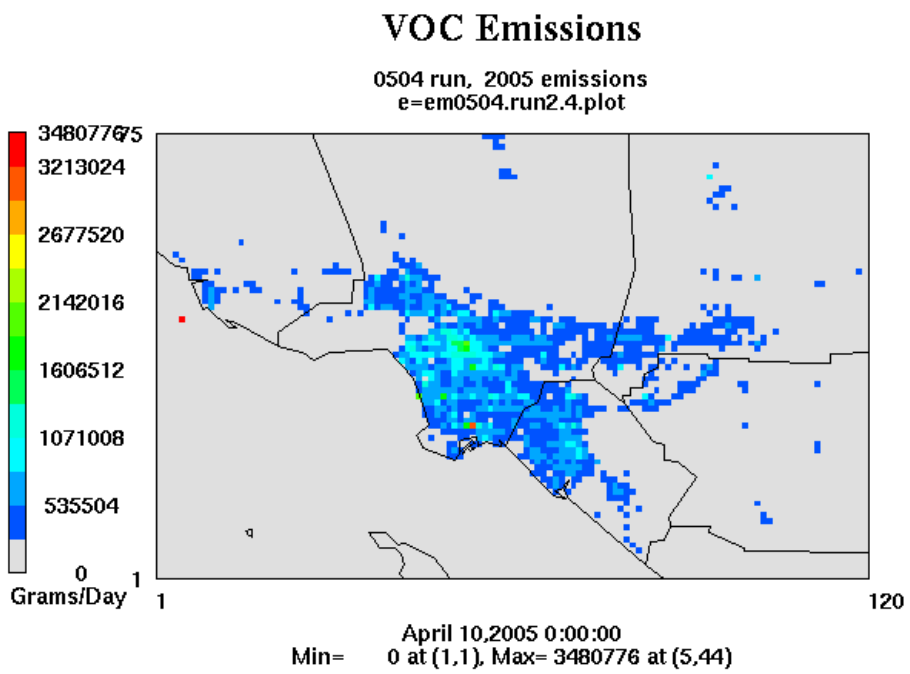

FIGURE IX-7h
Weekday average VOC emissions pattern

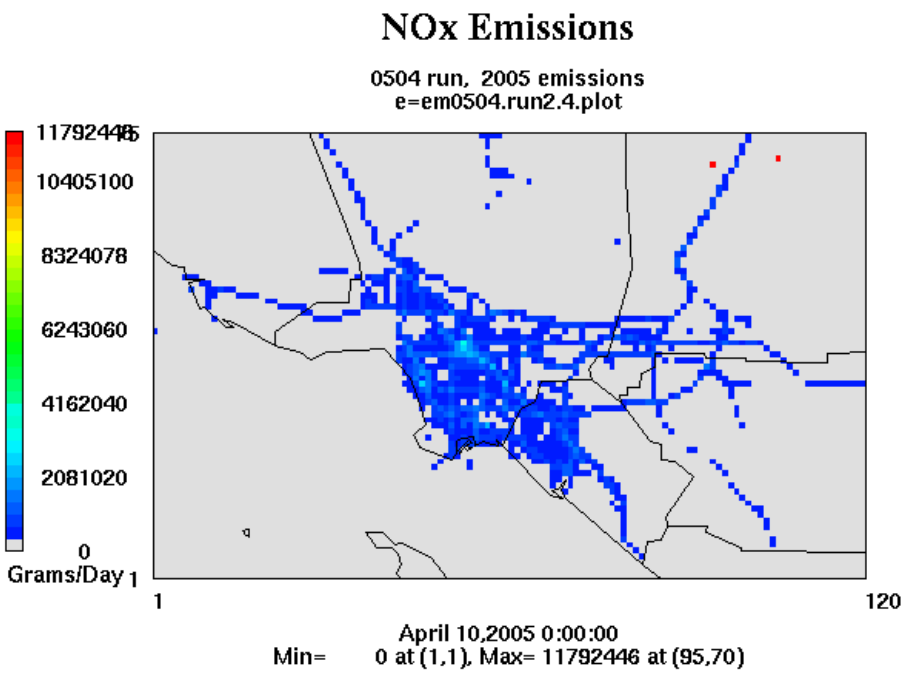

FIGURE IX-7i
Weekday average NOx emissions pattern

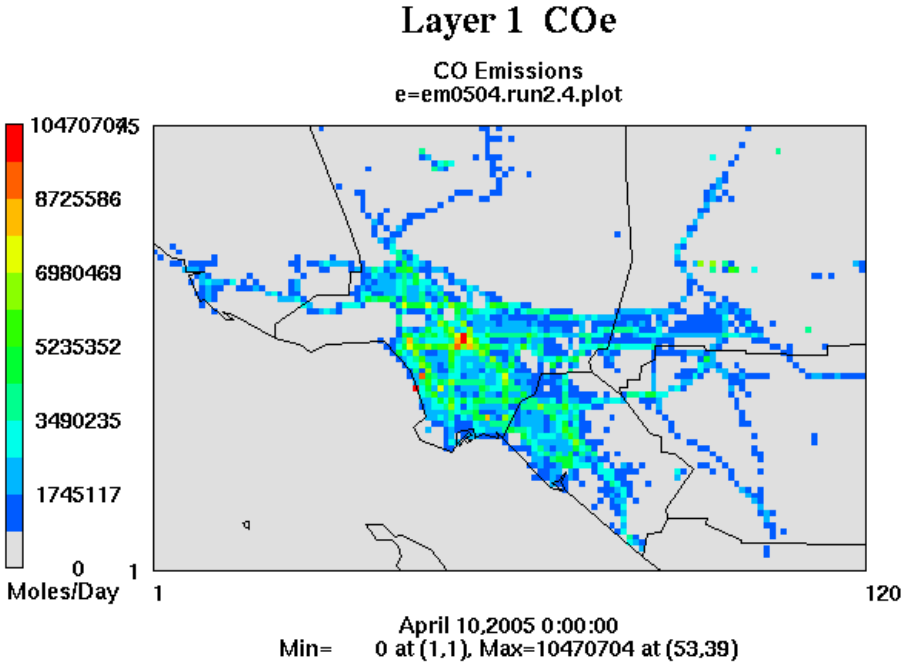

FIGURE IX-7j
Weekday average CO emissions pattern

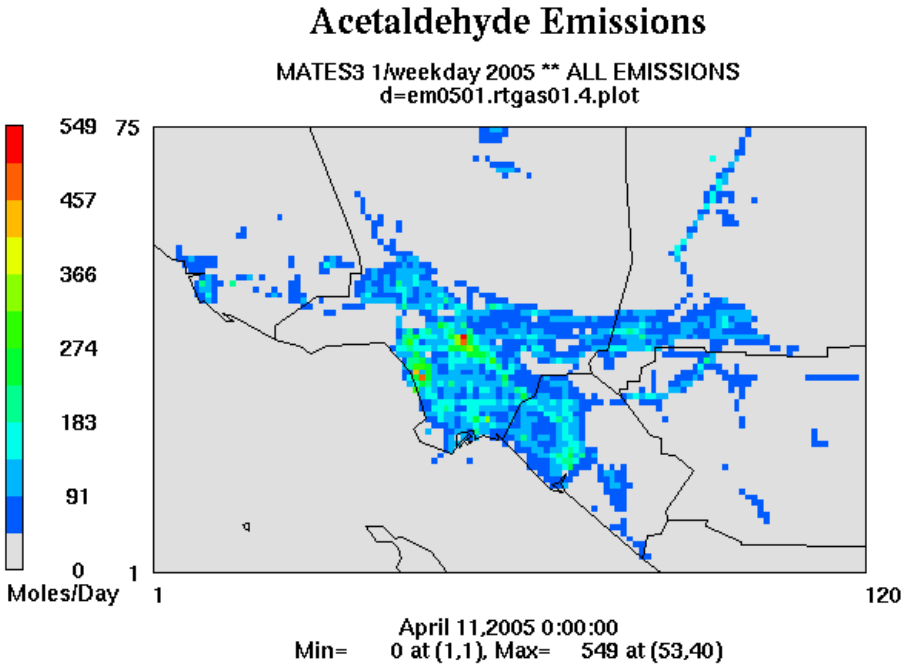

FIGURE IX-7k
Weekday average emissions pattern for Acetaldehyde

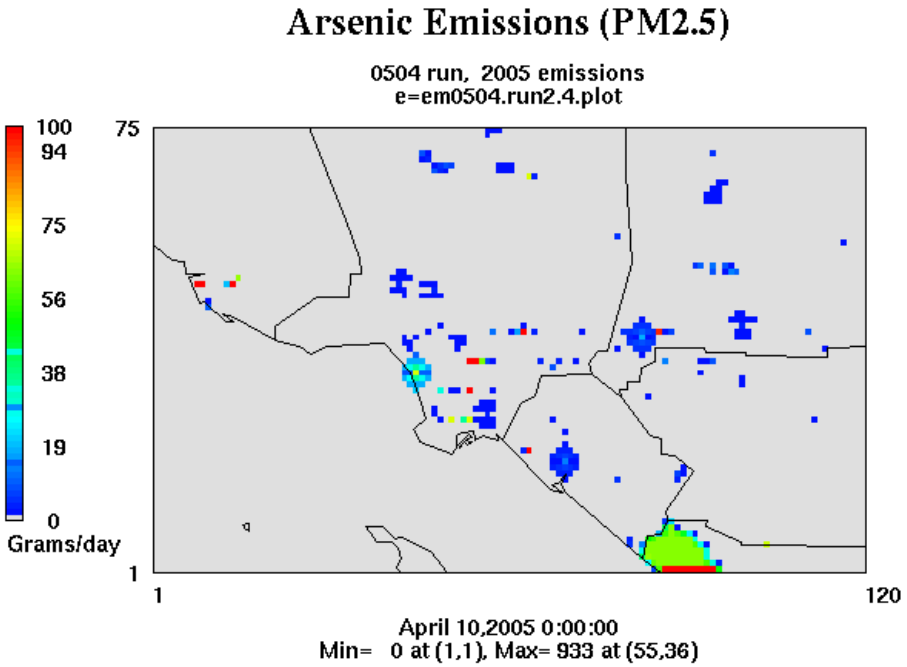

FIGURE IX-7l
Weekday average Arsenic emissions pattern

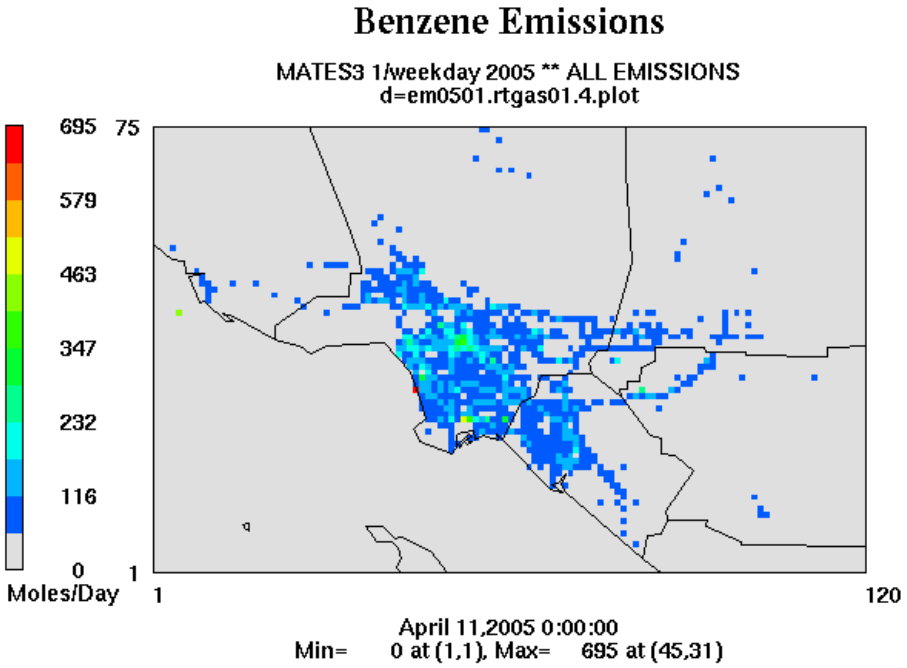

FIGURE IX-7m
Weekday average Benzene emissions pattern

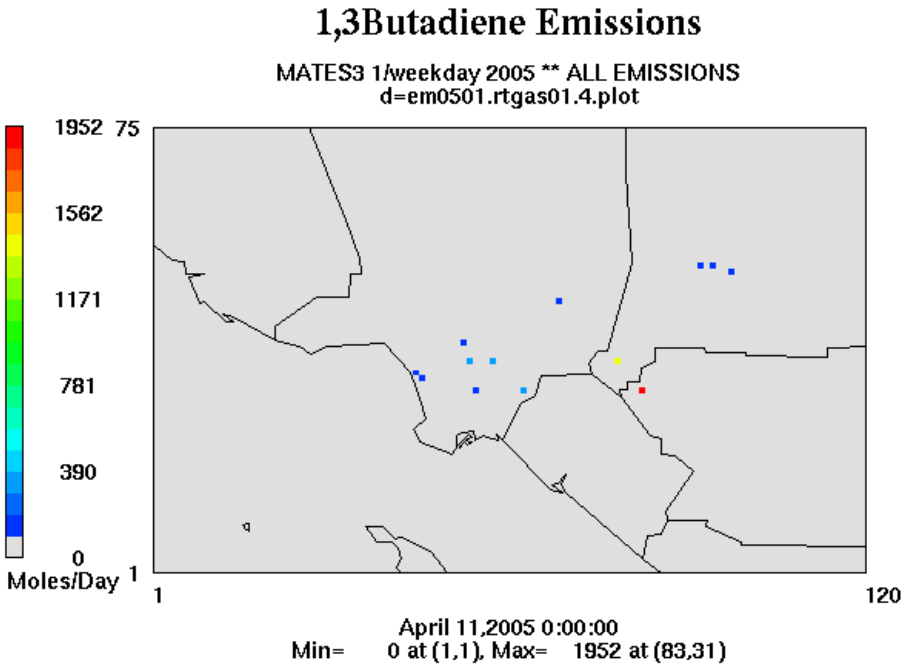

FIGURE IX-7n
Weekday average 1,3 Butadiene emissions pattern

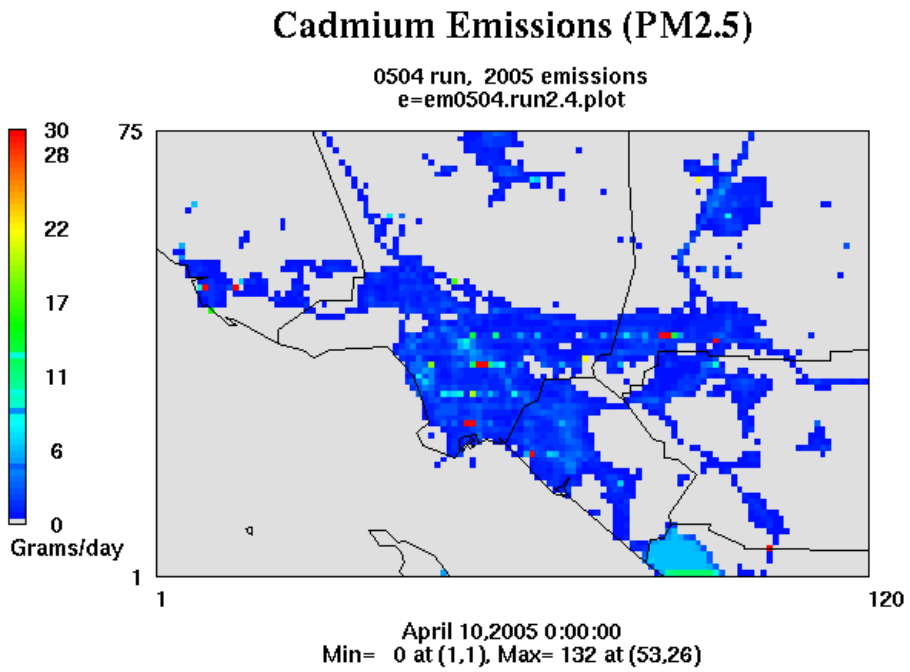

FIGURE IX-7o
Weekday average Cadmium $PM_{2.5}$ emissions pattern

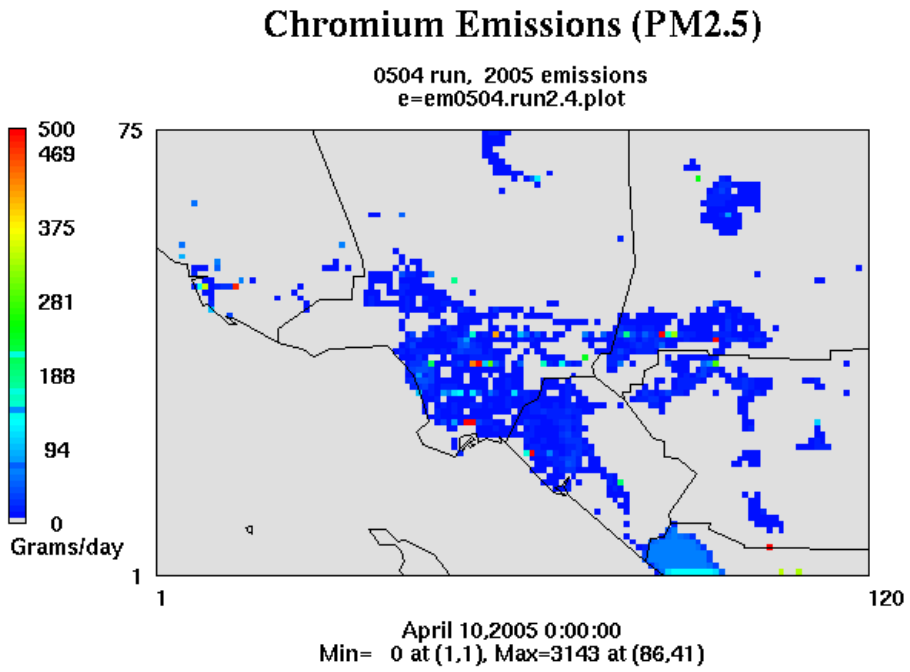

FIGURE IX-7p
Weekday average Chromium $PM_{2.5}$ emissions pattern

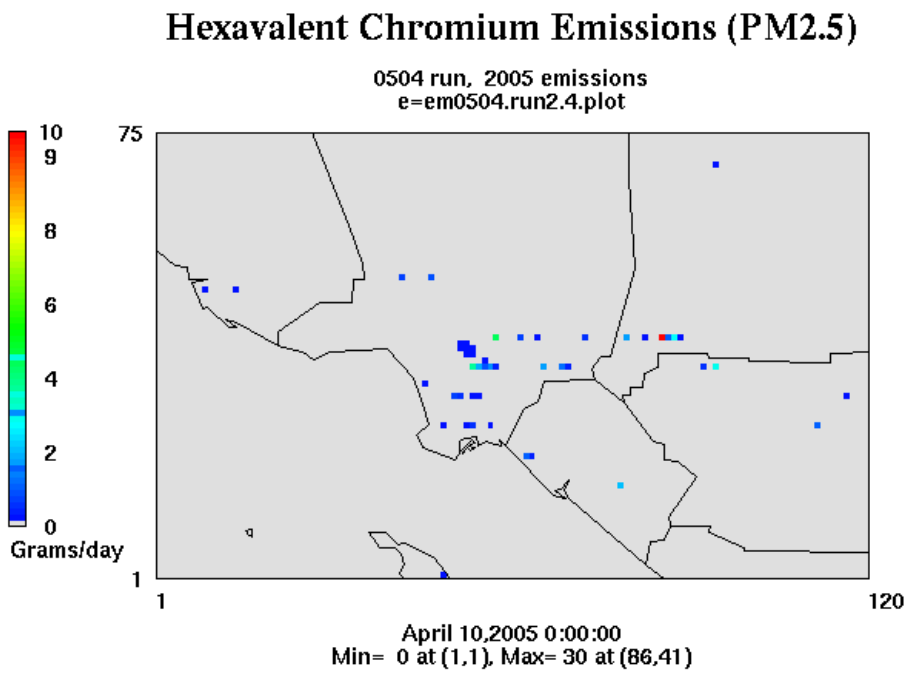

FIGURE IX-7q
Weekday average Hexavalent Chromium emissions pattern

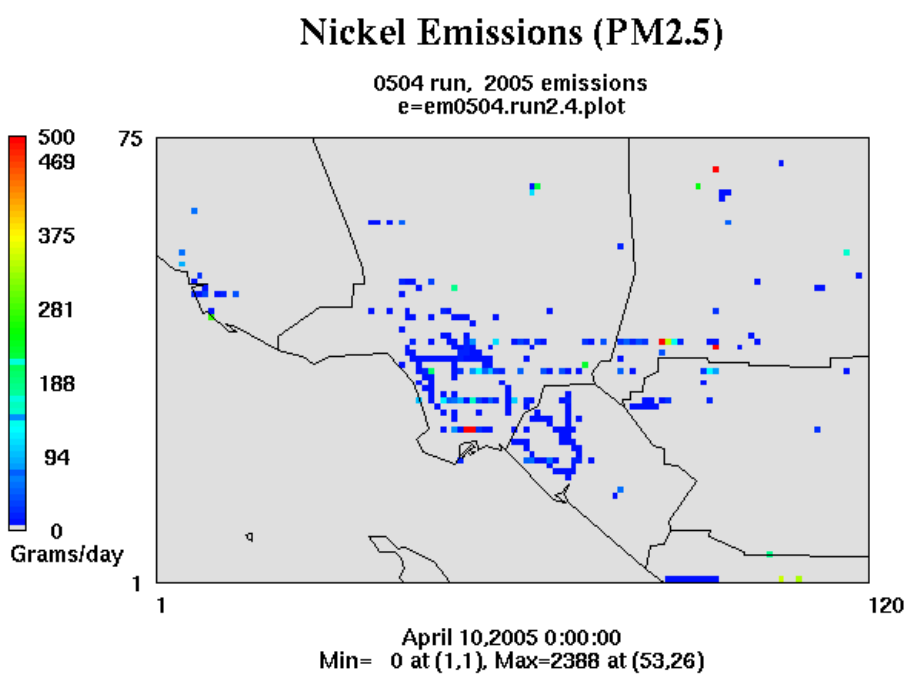

FIGURE IX-7r
Weekday average Nickel emissions pattern

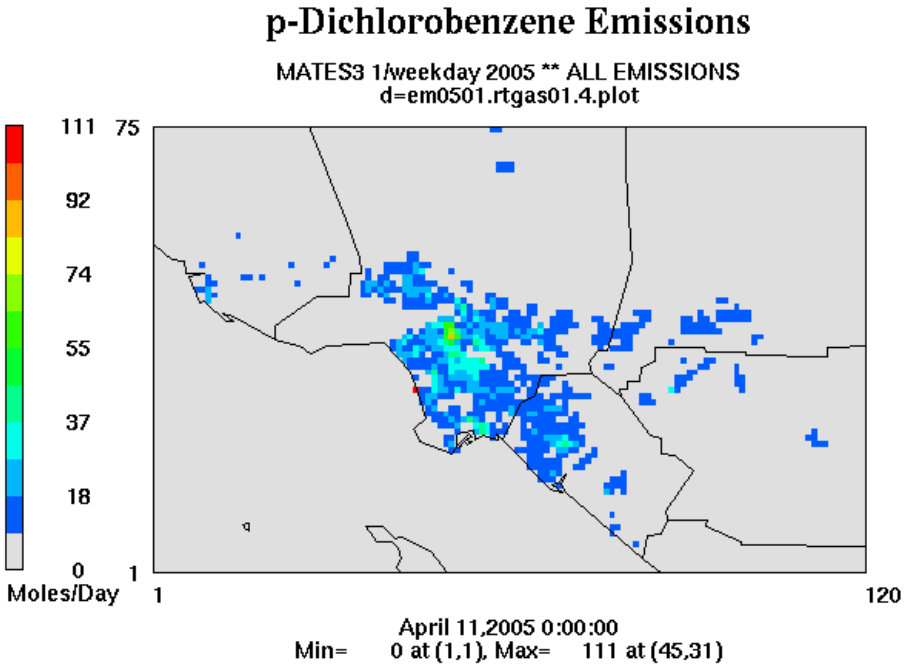

FIGURE IX-7s
Weekday average Nickel emissions pattern

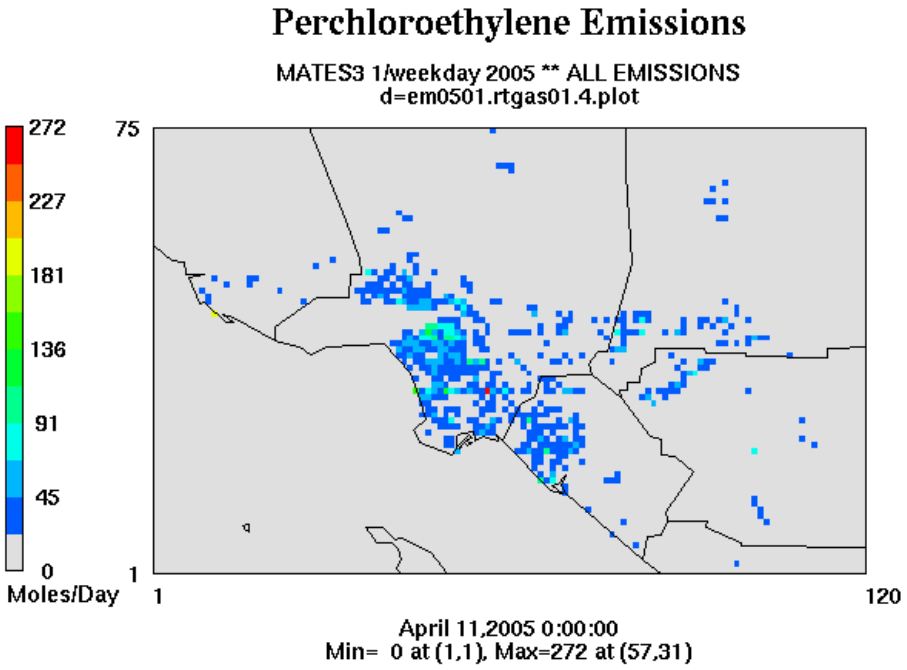

FIGURE IX-7t
Weekday average Perchloroethylene emissions pattern

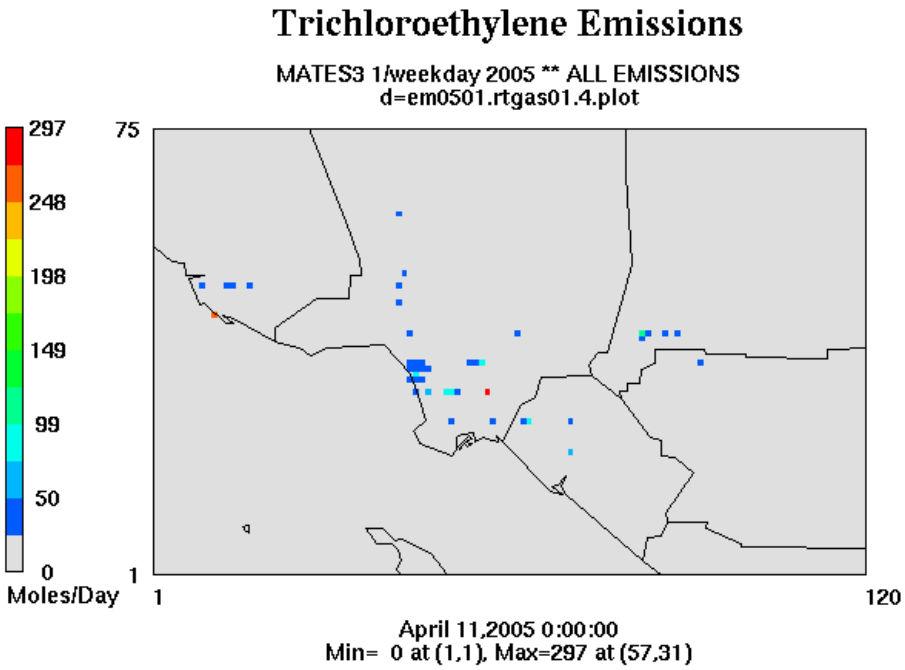

FIGURE IX-7u
Weekday average Trichloroethylene emissions pattern

MATES III vs. MATES II: Key Emissions Modeling Assumptions

Two changes to emissions data preparation were implemented in the MATES III modeling. First, emissions from vessels in the shipping lanes were assumed emitted into the first two vertical modeling layers to better estimate plume rise from the hot stack emissions. Combined stack heights and plume rise for typical ocean-going (deep draft) vessels extend above 36 and below 73 meters (WRAP, 2007). MATES II held shipping emissions in the first vertical UAM layer. It is important to note the differences between UAM and CAMx in that CAMx uses a fixed terrain following verticals structure and UAM layers were variable in depth. The UAM layers are defined by mixing depth and the first layer is typically a minimum of 150 m deep over land but drops to 50 m, or lower, over water. The CAMx vertical layer structure is independent of mixing depth and was fixed with the top of layer-1 set at 30 m and layer-2 at 90 m. Consequently, on days with low mixing depths, emissions locked into layer-1 of the UAM dispersion platform would be more concentrated having a higher ground level impact than for the CAMx solution.

The second modification impacted the distribution of truck movement throughout the Basin. At the time of MATES II, no heavy duty truck movement profile was available to characterize the truck distribution and travel on freeways, arterial and major streets. Truck travel was assigned the travel model characteristics designated for light duty passenger vehicle travel. MATES III directly incorporated the output of the heavy duty

truck demand model to provide a more realistic characterization of weekday travel. Weekend travel was assigned the same routes but at substantially lowered demand.

A brief assessment of the changes made to the modeling emissions from MATES II to MATES III showed that for diesel 97 percent of the grids exhibited net changes of 10 kg/ day or less. The maximum change in grid level emissions ranged from -81 kg/day to 120 kg/day. (A positive number indicates an increase in emissions from the MATES II inventory to MATES III). Overall, the shift in the emissions pattern from MATES II to MATES III reflects relatively small increments of emissions increase or decrease. Refinements to travel patterns, and shipping result in more clearly defined offshore shipping routes and enhanced diesel emissions along Interstate 5 and 710. Reductions in diesel emissions are noted in southwestern San Bernardino and northwestern Riverside Counties.

Boundary and Initial Conditions

The MATES III boundary differed significantly from those used in MATES II. Overall, the concentrations were lower and unlike MATES II, the boundary conditions were not uniform. The boundaries along the eastern and western portions of the modeling domain were sectioned into thirds and the north and south boundaries were apportioned into fifths. Each section of the four boundaries was assigned a unique value. Table IX-3 provides the boundary assignments. The western and southern boundaries were scaled to show a diminishing concentration as the southwest corner of the modeling domain was approached. The overland boundaries residing over populated areas or grid cells in major transportation corridors were assigned higher boundary concentrations compared with those cells over water or over mountains or desert areas.

The majority of the values of the boundary conditions and initial conditions were extracted from the 2005 annual $PM_{2.5}$ simulations used for the 2007 AQMP compliance demonstration. Boundary conditions for EC and diesel particulate were generated from model simulations using the larger SCOS97 modeling grid and a clean boundary assumption. (The MATES III grid is a subset of the SCOS97 modeling grid which encompasses 550 km in the east-west direction and 370 km in the north-south direction).

TABLE IX-3

Boundary Conditions for Gaseous Compounds (PPM): North and East Boundaries

Compound	North					East		
	N1	N2	N3	N4	N5	E1	E2	E3
NO	0.00017	0.00022	0.0002	0.00022	0.0002	0.00016	0.00016	0.00016
NO2	0.0028	0.0038	0.0038	0.00431	0.00395	0.00298	0.00297	0.00298
O3	0.05	0.05	0.049	0.05	0.05	0.05	0.05	0.05
OLE	0.0007	0.00082	0.00106	0.00115	0.0012	0.001393	0.001393	0.001393
PAR	0.019	0.021	0.023	0.023	0.0239	0.02571	0.02571	0.02571
TOL	0.00023	0.0003	0.00033	0.00032	0.00036	0.00038	0.00038	0.00038
XYL	0.00009	0.000116	0.00011	0.00009	0.000109	0.000112	0.000112	0.000112
FORM	0.002	0.0021	0.0021	0.00203	0.00201	0.00238	0.00238	0.00238
ALD2	0.001	0.0012	0.00132	0.00136	0.0014	0.00163	0.00163	0.00163
ETH	0.00041	0.000542	0.000636	0.0006	0.00061	0.0006	0.0006	0.0006
CRES	0.000007	0.000007	0.000007	0.000007	0.000007	0.000009	0.000009	0.000009
MGLY	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
OPEN	0.000002	0.000002	0.000002	0.000002	0.000002	0.000003	0.000003	0.000003
PNA	0.00001	0.00001	0.000012	0.000011	0.000011	0.000008	0.000008	0.000008
NXOY	0.00007	0.00008	0.000095	0.000103	0.000115	0.00007	0.00007	0.00007
PAN	0.00059	0.00058	0.000565	0.00054	0.00054	0.0005	0.0005	0.0005
CO	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
HONO	0.000002	0.000003	0.000003	0.000003	0.000003	0.000004	0.000004	0.000004
H2O2	0.0018	0.0017	0.00165	0.0016	0.00165	0.00187	0.00187	0.00187
MEOH	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
ETOH	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
ISOP	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
BENZ	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
BUTA	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037
PACET	0.0001	0.00012	0.000132	0.000136	0.00014	0.000163	0.000163	0.000163
HCHO	0.0002	0.00021	0.00021	0.000203	0.000201	0.000238	0.000238	0.000238
SACET	0.00045	0.00054	0.0006	0.00061	0.00063	0.000735	0.000735	0.000735
SFORM	0.0009	0.00095	0.00095	0.00092	0.000945	0.00107	0.00107	0.00107
PDIC	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
MCHL	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
PERC	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
TCE	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
NAPH	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001

TABLE IX-3 (Continued)

Boundary Conditions for Gaseous Compounds (PPM): West and South Boundaries

Compound	West			South				
	W1	W2	W3	S1	S2	S3	S4	S5
NO	0.000128	0.00035	0.000325	0.00014	0.00028	0.00039	0.000585	0.00052
NO2	0.00103	0.00311	0.00317	0.00115	0.002	0.00426	0.0077	0.00664
O3	0.044	0.044	0.047	0.045	0.046	0.045	0.044	0.047
OLE	0.000069	0.000155	0.000389	0.00007	0.0001	0.000365	0.000928	0.001248
PAR	0.0108	0.0182	0.0204	0.011	0.015	0.0221	0.03485	0.0349
TOL	0.000096	0.000183	0.000213	0.00012	0.00017	0.00038	0.000855	0.0008
XYL	0.000031	0.000073	0.000081	0.00004	0.00007	0.000165	0.000381	0.000352
FORM	0.000637	0.00098	0.00167	0.00061	0.00073	0.00105	0.00173	0.00222
ALD2	0.000242	0.000422	0.000687	0.00024	0.0003	0.00058	0.00114	0.00139
ETH	0.000099	0.000175	0.000343	0.0001	0.00015	0.000349	0.000658	0.000827
CRES	0.000004	0.000006	0.000006	0.000004	0.000006	0.00001	0.000019	0.000019
MGLY	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
OPEN	0.000001	0.0000015	0.000001	0.000001	0.000002	0.000003	0.000005	0.000005
PNA	0.000004	0.000006	0.000009	0.000004	0.000004	0.000008	0.000013	0.000016
NXOY	0.00005	0.00006	0.000048	0.00005	0.0001	0.000125	0.000134	0.000112
PAN	0.0003	0.000413	0.00051	0.0003	0.00034	0.000427	0.000565	0.000657
CO	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
HONO	0.000002	0.000005	0.000004	0.000002	0.000003	0.000005	0.000007	0.000006
H2O2	0.00114	0.00127	0.00163	0.0011	0.0012	0.0013	0.00145	0.00168
MEOH	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
ETOH	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
ISOP	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
BENZ	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
BUTA	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037	0.0000037
PACET	0.0000242	0.000042	0.0000687	0.000024	0.00003	0.000058	0.000114	0.000139
HCHO	0.0000637	0.000098	0.000167	0.000063	0.000073	0.000105	0.000173	0.000222
SACET	0.000109	0.00019	0.000618	0.000108	0.000135	0.00026	0.000501	0.000625
SFORM	0.000285	0.00044	0.0015	0.000275	0.00032	0.000475	0.00078	0.001
PDIC	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
MCHL	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
PERC	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
TCE	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
NAPH	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001

TABLE IX-3 (Continued)

Boundary Conditions for Particulate Compounds (μg/m3): North and East Boundaries

Compound	North (Fine)					East (Fine)		
	N1	N2	N3	N4	N5	E1	E2	E3
AR	0.00004	0.0001	0.000144	0.0004	0.0004	0.00034	0.0002	0.000192
CD	0.000013	0.00003	0.0000425	0.000125	0.000125	0.000108	0.0000625	0.00006
CR	0.0001	0.00025	0.00034	0.001	0.001	0.00085	0.0005	0.00048
CR6	0.00001	0.00002	0.00002	0.00008	0.0001	0.00007	0.000045	0.000045
DPMa	0.078	0.117	0.085	0.3	0.29	0.104	0.075	0.084
DPMb	0.029	0.068	0.093	0.222	0.188	0.15	0.108	0.088
DPMc	0.0017	0.0041	0.005	0.0127	0.0123	0.0103	0.0055	0.00475
DPMd	0.0014	0.0034	0.0044	0.035	0.037	0.0075	0.0084	0.0123
DPMe	0.0088	0.01	0.011	0.0075	0.0055	0.005	0.0037	0.00246
DSL	0.119	0.2	0.2	0.58	0.503	0.278	0.201	0.192
EC	0.059	0.11	0.128	0.3	0.283	0.154	0.124	0.125
NI	0.000056	0.00014	0.00019	0.00056	0.00056	0.000476	0.00028	0.000269
OC	0.011	0.22	0.255	0.61	0.66	0.336	0.257	0.25
PB	0.00017	0.000425	0.00056	0.0017	0.0017	0.001445	0.00085	0.000817
	North (Coarse)					East (Coarse)		
	N1	N2	N3	N4	N5	E1	E2	E3
ARC	0.00005	0.00012	0.00022	0.0004	0.0004	0.000276	0.00016	0.000152
CDC	0.000014	0.00004	0.0000688	0.000125	0.000125	0.000086	0.00005	0.000048
CR6C	0.000001	0.000001	0.000001	0.00001	0.00001	0.000005	0.000005	0.000005
CRC	0.00012	0.0003	0.00055	0.001	0.001	0.00069	0.0004	0.00038
DPMaC	0.005	0.0072	0.005	0.017	0.016	0.0045	0.003	0.0034
DPMbC	0.0013	0.0027	0.006	0.0084	0.006	0.00625	0.00429	0.003
DPMcC	0.00003	0.00007	0.00011	0.00017	0.00016	0.000235	0.00011	0.00014
DPMdC	0.00006	0.00013	0.0005	0.0028	0.0023	0.00033	0.00037	0.0006
DPMeC	0.0005	0.00041	0.0004	0.00022	0.00018	0.00025	0.00016	0.0001
DSLC	0.008	0.01	0.0124	0.028	0.025	0.0116	0.008	0.0072
ECC	0.011	0.023	0.034	0.072	0.071	0.036	0.029	0.0319
NIC	0.000067	0.00017	0.00031	0.00056	0.00056	0.000386	0.000216	0.000213
OCC	0.07	0.15	0.25	0.36	0.29	0.261	0.154	0.135
PBC	0.0002	0.00051	0.00093	0.0017	0.0017	0.00117	0.00068	0.000646

TABLE IX-3 (Continued)

Boundary Conditions for Particulate Compounds (µg/m3): West and South Boundaries

	West (Fine)			South (Fine)				
	W1	W2	W3	S1	S2	S3	S4	S5
AR	0.000002	0.000022	0.000032	0.000004	0.00014	0.00016	0.00044	0.00056
CD	6.3E-07	6.88E-06	0.00001	0.0000013	0.000043	0.00005	0.0001375	0.0002
CR	0.000005	0.000055	0.00008	0.00001	0.00034	0.0004	0.0011	0.0016
CR6	0.0000005	0.00001	0.00001	0.000001	0.00006	0.00007	0.00017	0.0002
DPMa	0.00016	0.00494	0.0078	0.00025	0.0013	0.003	0.096	0.143
DPMb	0.00034	0.0048	0.012	0.00055	0.0025	0.005	0.097	0.165
DPMc	0.015	0.0211	0.02	0.0245	0.0185	0.0216	0.025	0.0166
DPMd	0.000125	0.00125	0.00142	0.00014	0.00032	0.0005	0.00327	0.006
DPMe	0.0001	0.0015	0.0058	0.00013	0.00036	0.00058	0.0031	0.0055
DSL	0.0155	0.033	0.047	0.0255	0.023	0.031	0.219	0.335
EC	0.006	0.043	0.05	0.0097	0.019	0.028	0.134	0.196
NI	0.0000028	0.0000308	0.000045	0.0000056	0.00019	0.000226	0.000616	0.000896
OC	0.011	0.026	0.043	0.018	0.0175	0.025	0.223	0.377
PB	0.0000085	0.0000935	0.000126	0.000017	0.000578	0.00068	0.00187	0.00272
	West (Coarse)			South (Coarse)				
	W1	W2	W3	S1	S2	S3	S4	S5
ARC	0.0000006	0.000006	0.000026	0.0000004	0.000002	0.000008	0.00016	0.00028
CDC	0.0000002	1.88E-06	0.000008	1.3E-07	0.0000006	0.0000025	0.00005	0.0001
CR6C	1E-08	0.0000001	0.0000005	0.000001	0.000001	0.000001	0.000001	0.000005
CRC	0.0000015	0.000015	0.000065	0.000001	0.000005	0.00002	0.0004	0.0008
DPMaC	0.00001	0.00039	0.00055	0.000015	0.00007	0.00017	0.0065	0.0086
DPMbC	0.00002	0.00034	0.00082	0.00003	0.00013	0.00027	0.0065	0.0094
DPMcC	0.001	0.0015	0.00139	0.0015	0.00096	0.0011	0.00125	0.00063
DPMdC	0.00001	0.00009	0.0001	0.00001	0.00002	0.00003	0.00021	0.00032
DPMeC	0.000005	0.0001	0.00042	0.00001	0.00002	0.00003	0.0002	0.00018
DSLC	0.001	0.0024	0.0032	0.0015	0.0012	0.0016	0.0146	0.019
ECC	0.00036	0.0036	0.0065	0.0005	0.0011	0.0022	0.036	0.055
NIC	8.4E-07	0.0000084	0.000036	5.6E-07	0.0000028	0.0000112	0.000224	0.000448
OCC	0.0014	0.011	0.035	0.0019	0.0041	0.0079	0.236	0.392
PBC	2.55E-06	0.0000255	0.00011	0.0000017	0.0000085	0.000034	0.00068	0.00136

Modeling Results

The performance of the CAMx regional modeling simulation for the 2005 emissions and meteorology is summarized through model performance statistics and graphically through time series displays and bivariate plots of key projected pollutant concentrations. Table IX-3 provides the annual average model performance at the ten locations monitoring all or portions of the annual average toxic compounds. Summarized in Table IX-4 are the toxic components observed and simulated concentrations and the percentage mean absolute prediction error (PC). A very desirable score for PC for particulate compounds is within 30 percent as defined in EPA's modeling guidance for annual particulate simulations. Particulate (and gaseous) compounds meeting this goal are highlighted with a shadow in Table IX-4.

In general, elemental carbon (EC) performs well in the simulation. The EC performance is comparable to that observed in the 2007 AQMP annual $PM_{2.5}$ attainment demonstration. Performance for several of the minor toxic components varies. This in part can be attributed to very low measured concentrations nearing levels of detection, uncertainties in the emissions inventory and model performance in recreating dispersion patterns. Adding to the uncertainty is the nine-cell distance weighted averaging to recreate a measurement made at a discreet location.

For this assessment EC2.5 is used as a representative particulate component to further illustrate model performance. Table IX-5 provides the CAMx performance for EC2.5 at the 8 MATES III monitoring sites that have complete monitoring records for 2005. Three of the eight sites (Burbank, Fontana and Rubidoux) under predict the annual average EC2.5 concentration. The greatest tendency for over prediction is at North Long Beach. The mean absolute error of the simulated verses measured concentrations ranges from 0.59 $\mu g/m^3$ to 1.07 $\mu g/m^3$.

The time series fit of the simulated EC2.5 concentrations to measurements for each station is depicted in Figures IX-8a through IX-8h and in the cumulative 8-site combined bivariate plot shown in Figure IX-9. The time series depiction of the measured and simulated EC2.5 echo the statistical evaluation whereby concentrations are under predicted throughout the year at Burbank and Riverside with the greatest margin occurring in the fall and early winter periods. Similarly, EC2.5 at Fontana is under predicted in the second half of the year. The time series for the other sites show a general tendency to nominally over predict in the summer but capture the trend in the fall and winter.

In Figure IX-9, the cumulative EC2.5 predictions for the 8-sites combined show an overall tendency towards under prediction however a large percent of the predictions are within 30 percent of the measured concentrations.

Table IX-4

2005 Station Observed and CAMx Simulated MATES III Annual Average Concentrations

Substance	Units	Anaheim			Burbank			Compton			Fontana		
		Obs	Model	PC	Obs	Model	PC	Obs	Model	PC	Obs	Model	PC30
1,3Butadiene	ppb	0.06	0.08	33	0.14	0.07	50	0.16	0.14	13	0.05	0.05	0
Acetaldehyde	ppb	1.28	1.16	9	1.94	1.24	36	1.58	1.21	23	1.89	1.25	34
As (2.5)	ηg/m^3	0.51	0.79	55	0.53	0.58	9	0.48	2.1	338	0.55	1.04	89
As (TSP)	ηg/m^3	0.48	1.96	308	0.77	1.57	104	0.68	3.52	418	0.75	2.56	241
Benzene	ppb	0.44	0.5	14	0.72	0.47	35	0.81	0.56	31	0.49	0.4	18
Cd (2.5)	ηg/m^3	2.16	0.37	83	1.31	0.24	82	1.71	0.76	56	1.73	0.75	57
Cd (TSP)	ηg/m^3	1.59	0.65	59	1.49	0.42	72	1.43	1.06	26	1.69	1.15	32
Cr6 (TSP)	ηg/m^3	0.12	0.05	58	0.17	0.04	76	0.31	0.06	81	0.2	0.25	25
Diesel (2.5)	µg/m^3		2.71			1.94			2.9			1.95	
Diesel (PM_{10})	µg/m^3		2.9			2.07			3.11			2.07	
EC10	µg/m^3	1.63	1.93	18	2.39	1.44	40	1.88	2.51	34	2.42	1.96	19
EC2.5	µg/m^3	1.43	1.47	3	2.08	1.1	47	1.79	2.01	12	2.17	1.57	28
Formaldehyde	ppb	2.96	3.1	5	3.85	3.17	18	3.14	3.44	10	3.68	3.06	17
Methylene Chloride	ppb	0.23	0.36	57	0.34	0.28	18	0.37	0.38	3	0.18	0.15	17
Naphthalene	ppb		0.02			0.02			0.02			0.01	
Ni (2.5))	ηg/m^3	3.9	1.68	57	3.28	1.22	63	4.25	5.86	38	2.98	6.47	117
Ni (TSP)	ηg/m^3	3.87	3.17	18	3.74	2.2	41	5.94	8.18	38	3.57	9.8	175
Pb (2.5)	ηg/m^3	3.57	2.12	41	4.7	1.41	70	6.28	2.51	60	8.68	5.28	39
Pb (TSP)	ηg/m^3	6.31	9.17	45	10.29	5.93	42	11.79	8.58	27	13.59	11.23	17
p-Dichlorobenzene	ppb	0.02	0.08	300	0.03	0.08	167	0.06	0.11	83	0.02	0.04	100
Perchloroethylene	ppb	0.06	0.1	67	0.1	0.1	0	0.12	0.13	8	0.05	0.06	20
Trichloroethylene	ppb	0.01	0.03	200	0.03	0.03	0	0.01	0.05	400	0.01	0.03	200

Table IX-4 (Continued)

2005 Station Observed and CAMx Simulated MATES III Annual Average Concentrations

Substance	Units	Huntington Park (Less than 12 Months)			North Long Beach			Los Angeles			Pico Rivera (Less than 12 Months)		
		Observed	Model	PC	Observed	Model	PC	Obs	Model	PC	Obs	Model	PC
1,3Butadiene	ppb	0.21	0.27	29	0.08	0.09	13	0.11	0.12	9	0.13	0.1	23
Acetaldehyde	ppb	1.59	1.35	15	1.26	1.21	4	1.77	1.51	15	1.72	1.32	23
As (2.5)	ηg/m^3	1.52	6.96	358	0.52	0.92	77	0.52	1.54	196	0.83	2.48	199
As (TSP)	ηg/m^3	1.45	9.09	527	0.65	2.21	240	0.66	4.07	517	1.02	3.85	277
Benzene	ppb	0.83	0.63	24	0.51	0.57	12	0.59	0.69	17	0.7	0.55	21
Cd (2.5)	ηg/m^3	2.17	0.66	70	1.56	0.73	53	1.39	0.51	63	1.21	0.45	63
Cd (TSP)	ηg/m^3	1.47	1.04	29	1.64	0.98	40	1.45	0.87	40	1.38	0.73	47
Cr6 (TSP)	ηg/m^3	0.23	0.12	48	0.18	0.05	72	0.18	0.06	67	0.17	0.06	65
Diesel (2.5)	µg/m^3		3.15		3.85	3.85			3.89			3.04	
Diesel (PM_{10})	µg/m^3		3.38		3.85	4.13			4.18			3.25	
EC10	µg/m^3	2.64	2.91	10	1.86	2.54	37	2.06	2.79	35	2.67	2.32	13
EC2.5	µg/m^3	2.36	2.22	6	1.44	2.04	42	1.97	2.15	9	2.36	1.78	25
Formaldehyde	ppb	3.71	4.11	11	3.5	3.46	1	4.22	4.39	4	3.52	3.5	1
Methylene Chloride	ppb	0.39	0.53	36	1.89	0.23	88	0.38	0.58	53	0.31	0.32	3
Naphthalene	ppb		0.03			0.02			0.03			0.02	
Ni (2.5))	ηg/m^3	2.4	4.11	71	4.05	5.86	45	3.92	3.05	22	3.2	2.52	21
Ni (TSP)	ηg/m^3	5.46	6.76	24	6.48	9.11	41	4.8	5.1	6	4.89	4.13	16
Pb (2.5)	ηg/m^3	8.21	5.08	38	4.4	2.08	53	4.78	2.35	51	6.16	2.37	62
Pb (TSP)	ηg/m^3	19.12	12.91	32	8.72	7.91	9	14.08	10.57	25	15.6	8.5	46
p-Dichlorobenzene	ppb	0.07	0.14	100	0.02	0.08	300	0.03	0.12	300	0.03	0.08	167
Perchloroethylene	ppb	0.11	0.17	55	0.04	0.1	150	0.06	0.13	117	0.07	0.1	43
Trichloroethylene	ppb	0.02	0.06	200	0.01	0.04	300	0.02	0.04	100	0.02	0.03	50

Table IX-4 (Continued)

2005 Station Observed and CAMx Simulated MATES III Annual Average Concentrations

Substance	Units	Rubidoux			Wilmington/West Long Beach		
		Obs	Model	PC	Obs	Model	PC
1,3Butadiene	ppb	0.06	0.05	17	0.08	0.07	13
Acetaldehyde	ppb	1.66	1.17	30	1.41	1.15	18
As (2.5)	ηg/m^3	0.45	0.52	16	0.48	1.02	113
As (TSP)	ηg/m^3	0.83	1.6	93	1.18	2.37	101
Benzene	ppb	0.44	0.37	16	0.53	0.6	13
Cd (2.5)	ηg/m^3	1.47	0.27	82	1.47	1.19	19
Cd (TSP)	ηg/m^3	1.56	0.49	69	1.51	1.44	5
Cr6 (TSP)	ηg/m^3	0.39	0.06	85	0.26	0.06	77
Diesel (2.5)	µg/m^3		1.63			4.35	
Diesel (PM_{10})	µg/m^3		1.73			4.67	
EC10	µg/m^3	2.08	1.35	35	2.32	2.93	26
EC2.5	µg/m^3	1.71	1.03	40	2.07	2.5	21
Formaldehyde	ppb	3.44	2.77	19	3.34	3.35	0
Methylene Chloride	ppb	0.32	0.15	53	0.2	0.28	40
Naphthalene	ppb		0.01			0.02	
Ni (2.5))	ηg/m^3	3	1.59	47	7.25	11.2	54
Ni (TSP)	ηg/m^3	3.61	2.72	25	10.48	17.27	65
Pb (2.5)	ηg/m^3	6.31	1.69	73	4.71	2.52	46
Pb (TSP)	ηg/m^3	10.87	6.35	42	9.82	7.45	24
p-Dichlorobenzene	ppb	0.03	0.04	33	0.02	0.08	300
Perchloroethylene	ppb	0.03	0.06	100	0.04	0.08	100
Trichloroethylene	ppb		0.02		0.02	0.03	50

Table IX-5
Simulation Performance Statistics for $PM_{2.5}$ Elemental Carbon

Station	Measured ($\mu g/m^3$)	Predicted ($\mu g/m^3$)	Mean Error ($\mu g/m^3$)	Mean Absolute Error ($\mu g/m^3$)
Anaheim	1.41	1.47	0.06	0.59
Burbank	2.04	1.08	-0.93	1.07
Compton	1.74	2.00	0.33	0.74
Fontana	2.16	1.53	-0.58	0.99
North Long Beach	1.39	2.00	0.77	0.99
Los Angeles	1.93	2.12	0.25	0.83
Rubidoux	1.69	0.99	-0.67	0.84
Wilmington/West Long Beach	2.04	2.47	0.52	1.01

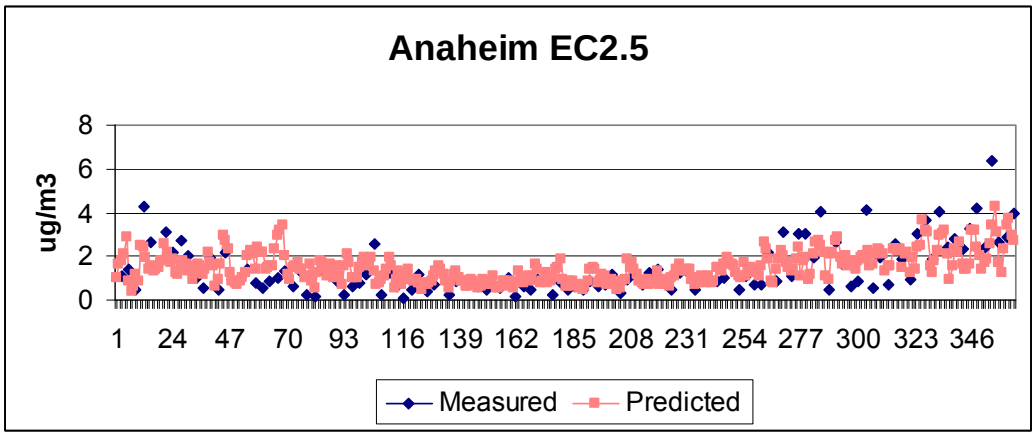

Figure IX-8a
EC2.5 Time Series: Simulated Vs. Measured at Anaheim

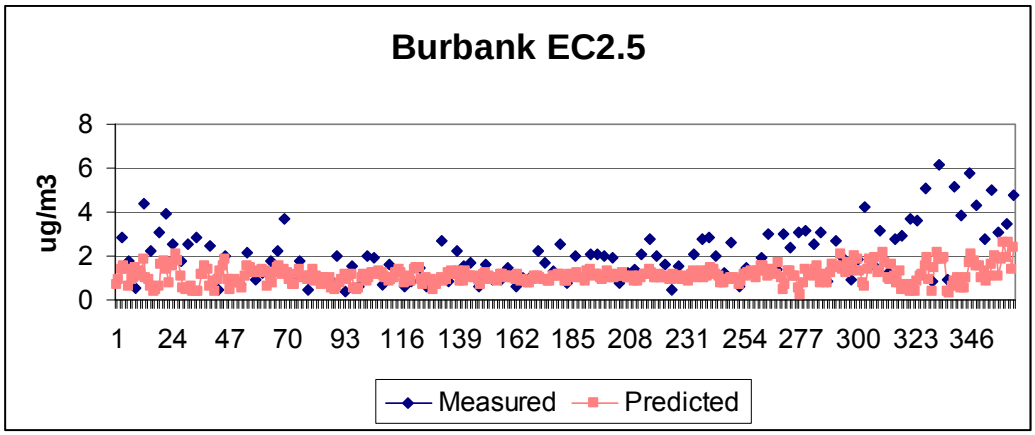

Figure IX-8b
EC2.5 Time Series: Simulated Vs. Measured at Burbank

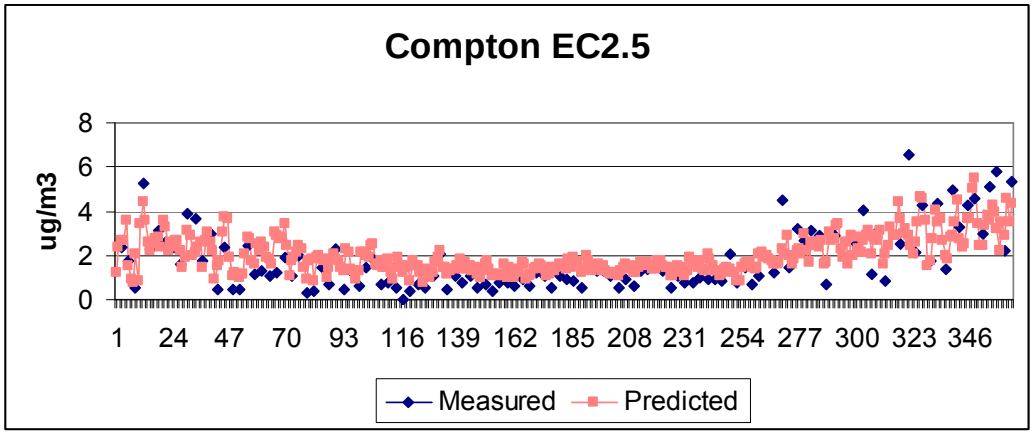

Figure IX-8c
EC2.5 Time Series: Simulated Vs. Measured at Compton

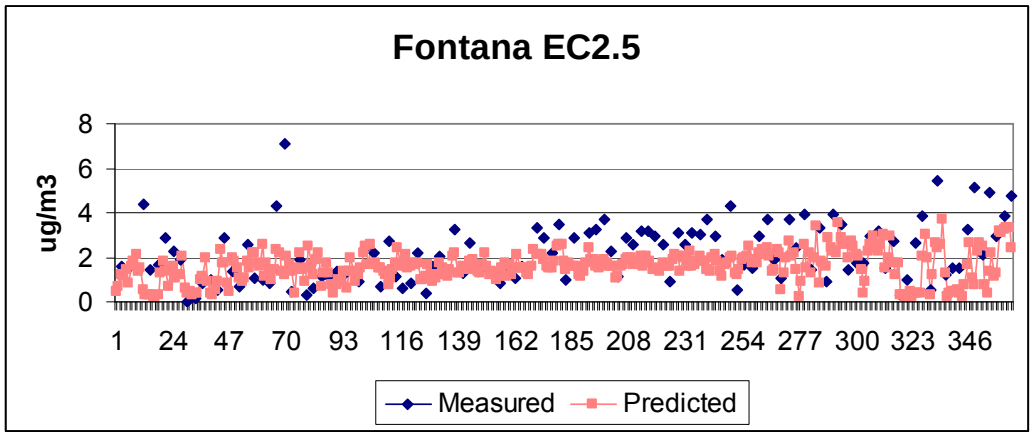

Figure IX-8d
EC2.5 Time Series: Simulated Vs. Measured at Fontana

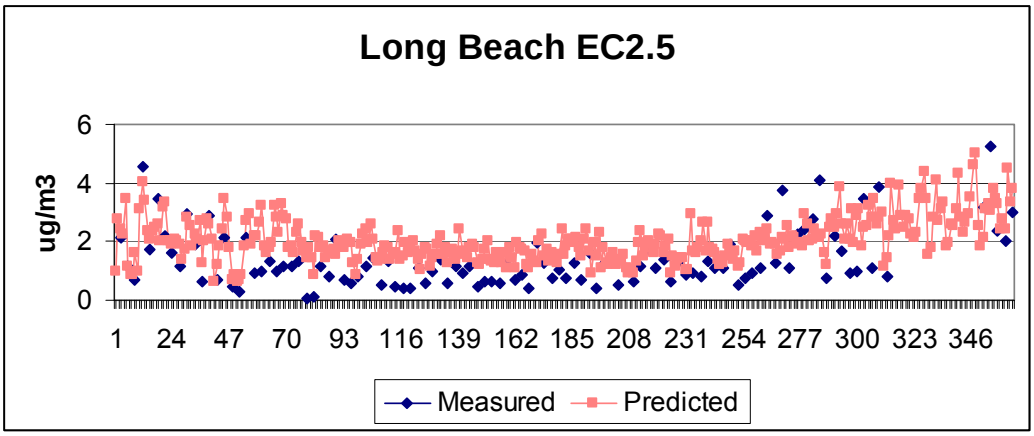

Figure IX-8e
EC2.5 Time Series: Simulated Vs. Measured at North Long Beach

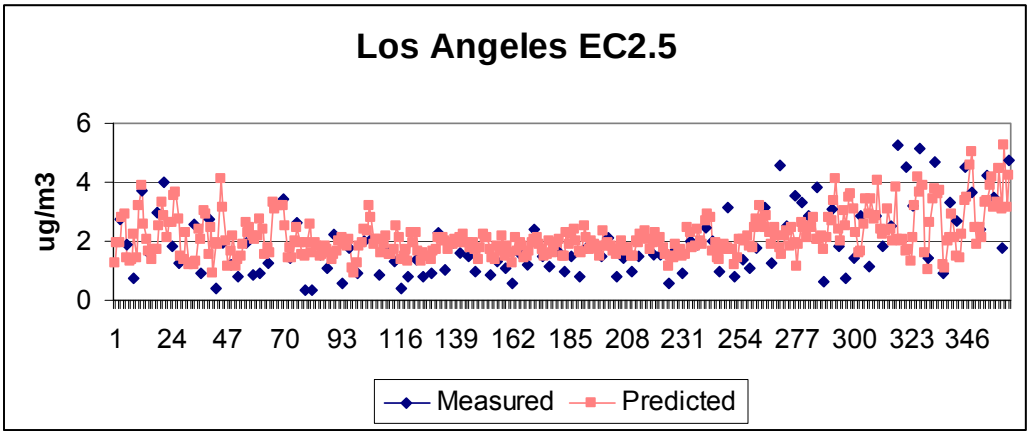

Figure IX-8f
EC2.5 Time Series: Simulated Vs. Measured at Los Angeles

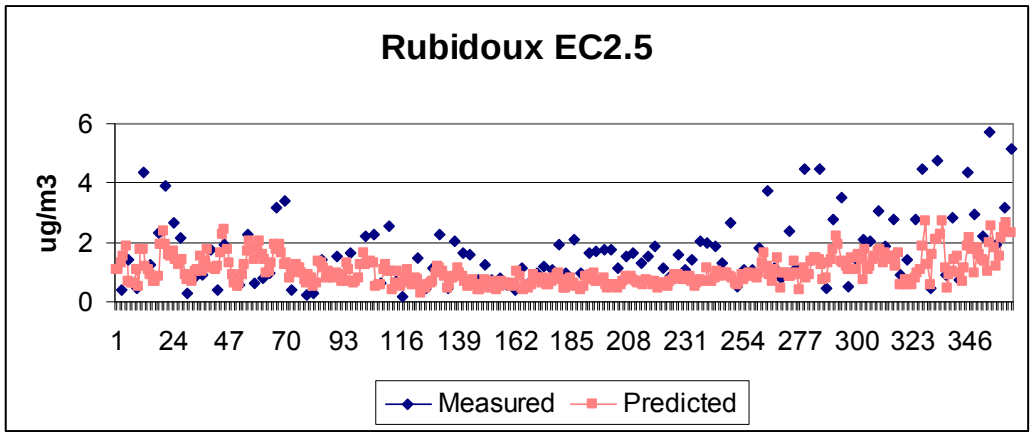

Figure IX-8g
EC2.5 Time Series: Simulated Vs. Measured at Rubidoux

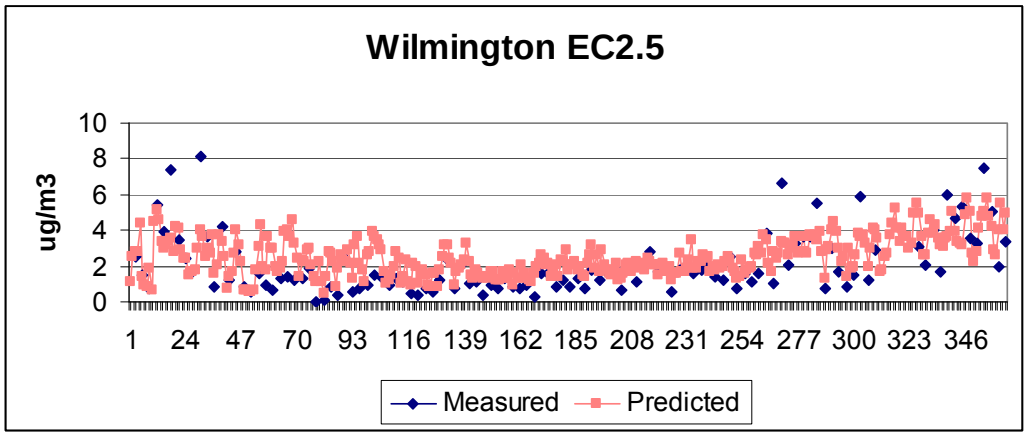

Figure IX-8h
EC2.5 Time Series: Simulated Vs. Measured at Wilmington/West Long Beach

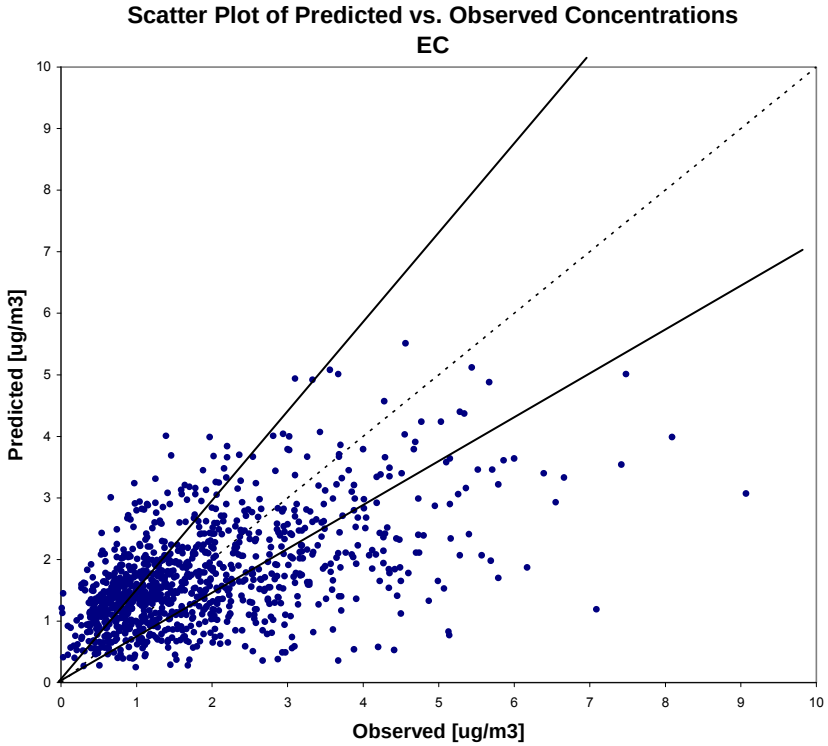

Figure IX-9
EC2.5 Bivariate Scatter Plot Simulated Vs. Measured All Stations

Table IX-6 summarizes the network average measured and predicted pollutant concentrations at the eight sites having a full year's data. No direct measurements of diesel $PM_{2.5}$ were available for comparison to the simulated annual average concentrations; however, estimates of diesel based on Chemical Mass Balance (CMB) analysis using ambient measured elemental carbon concentrations are discussed later in this section. Measured concentrations of naphthalene were available for Wilmington/West Long Beach, central Los Angeles and Riverside. Each of the four counties is represented by at least one station, with the greatest concentration occurring in Los Angeles (five sites). Averaging the measured and simulated concentrations at the eight stations provides an estimate of the regional profile but with a bias towards impacts to the coastal communities in the heavily transited areas of the Basin. Moreover, the assessment provides a direct comparison for model performance evaluation.

Overall model simulated average annual toxic compound concentrations compare well with the simulated annual average values. EC2.5 was well simulated as were the gaseous components. Arsenic, cadmium and nickel tend to be over predicted by an approximate factor of two but lead concentrations are closely recreated.

Figures IX-10a through IX-10u depict the CAMx projected annual average concentration distributions of selected toxic compounds as well as the impacts of five emissions categories of diesel particulates in the Basin. In general, the distribution of diesel particulates follows the major arterials. However, localized hot spots with annual average concentrations to 4.8 $\mu g/m^3$ are observed in the central Los Angeles area and 8.5 $\mu g/m^3$ at the Ports of Los Angeles and North Long Beach. Figures IX-10h and IX-10i provide the distributions of benzene and 1,3-butadiene respectively whereby the toxic compounds are almost uniformly distributed throughout the basin (reflecting patterns of light duty fuel consumption). The formaldehyde profile (Figure IX-10j) depicts higher concentrations in the heavily traveled western and central Basin with additional hot spots in the downwind areas of the Basin that are impacted by higher levels of ozone formation (Santa Clarita and Crestline).

Table IX-6
Toxic Compounds Simulated and Measured: 2005 Eight-Station Average

Toxic Compound	Units	Measured Annual Average	Simulated Annual Average
EC2.5	$\mu g/m^3$	1.83	1.89
Diesel (2.5)	$\mu g/m^3$	N/A	2.43
EC10	$\mu g/m^3$	2.08	2.34
Cr6 (TSP)	ng/m^3	0.23	0.08
As (2.5)	ng/m^3	0.51	1.49
As (TSP)	ng/m^3	0.75	3.01
Cd (2.5)	ng/m^3	1.60	0.76
Cd (TSP)	ng/m^3	1.55	1.06
Ni (2.5))	ng/m^3	4.08	7.56
Ni (TSP)	ng/m^3	5.31	12.87
Pb (2.5)	ng/m^3	5.43	2.92
Pb (TSP)	ng/m^3	10.68	8.95
Benzene	ppb	0.57	0.52
Perchloroethylene	ppb	0.06	0.09
p-Dichlorobenzene	ppb	0.03	0.08
Methylene Chloride	ppb	0.49	0.30
Trichloroethylene	ppb	0.02	0.03
1,3Butadiene	ppb	0.09	0.08
Formaldehyde	ppb	3.52	3.34
Acetaldehyde	ppb	1.60	1.24
Naphthalene	ppb	0.02*	0.02

* Three station average

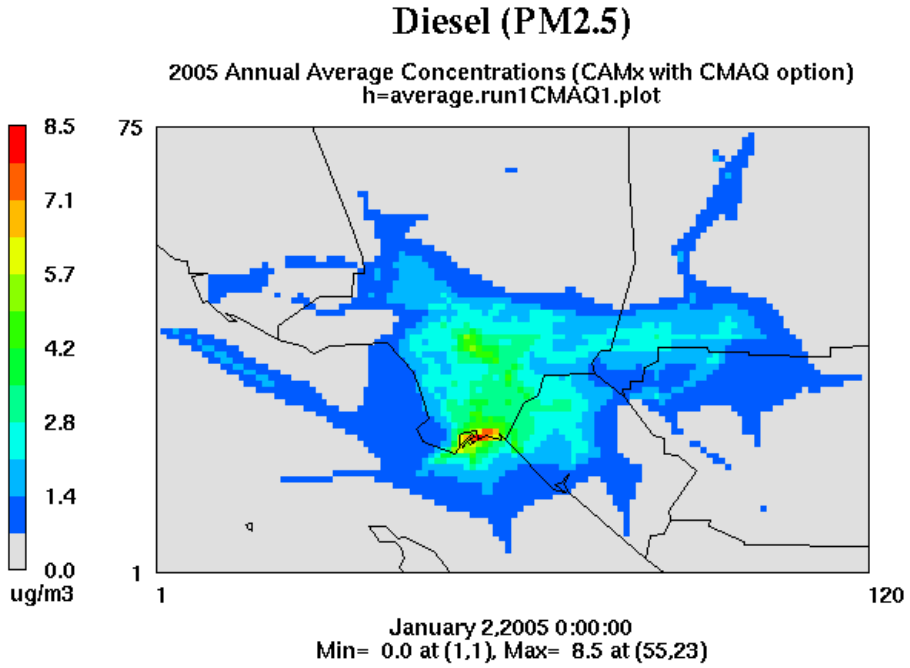

FIGURE IX-10a
CAMx simulated 2005 annual average Diesel $PM_{2.5}$

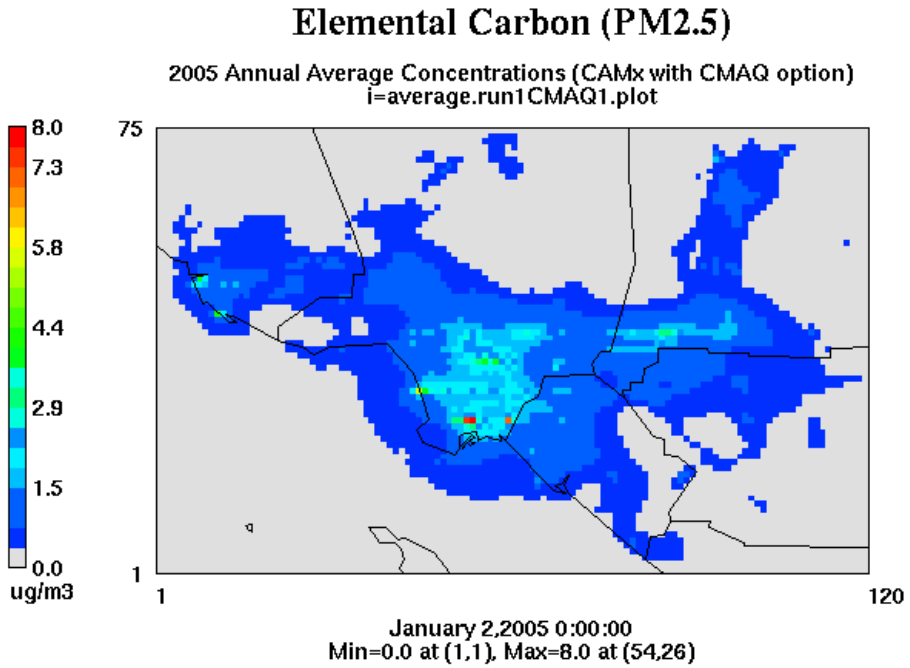

FIGURE IX-10b
CAMx simulated 2005 annual average Elemental Carbon $PM_{2.5}$

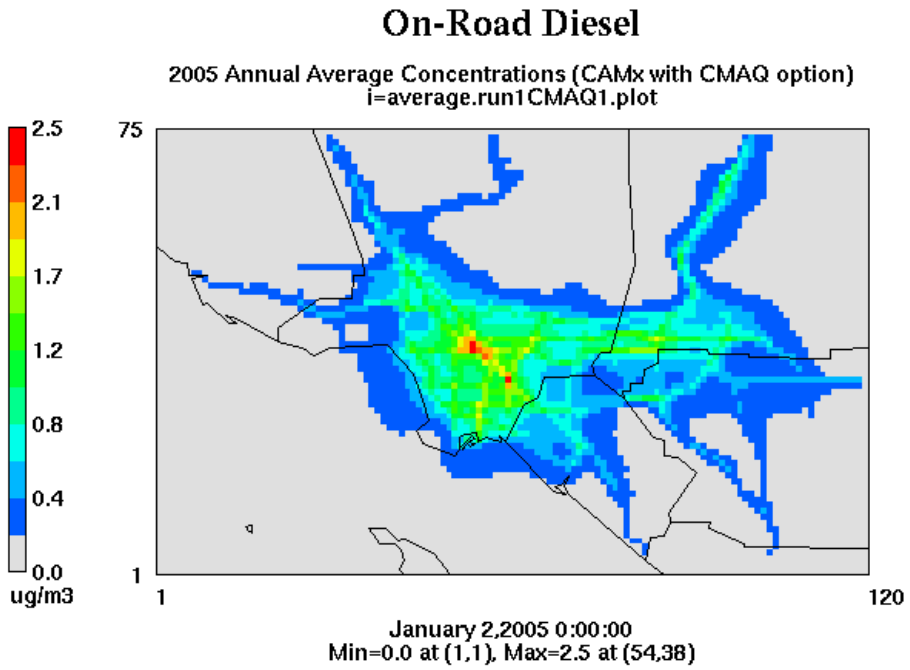

FIGURE IX-10c
CAMx simulated 2005 annual average On-Road Diesel $PM_{2.5}$

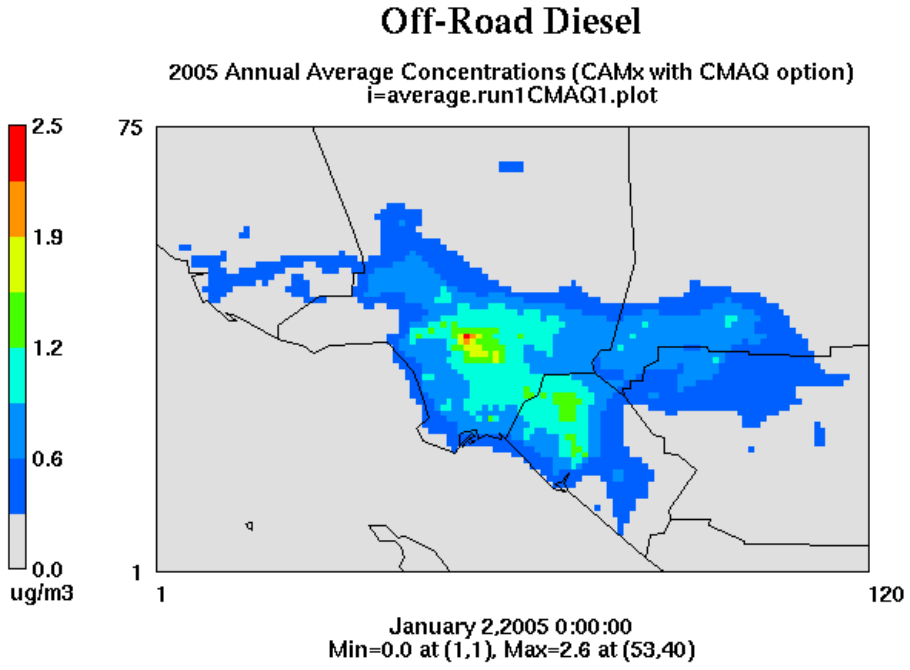

FIGURE IX-10d
CAMx simulated 2005 annual average Off-Road Diesel $PM_{2.5}$

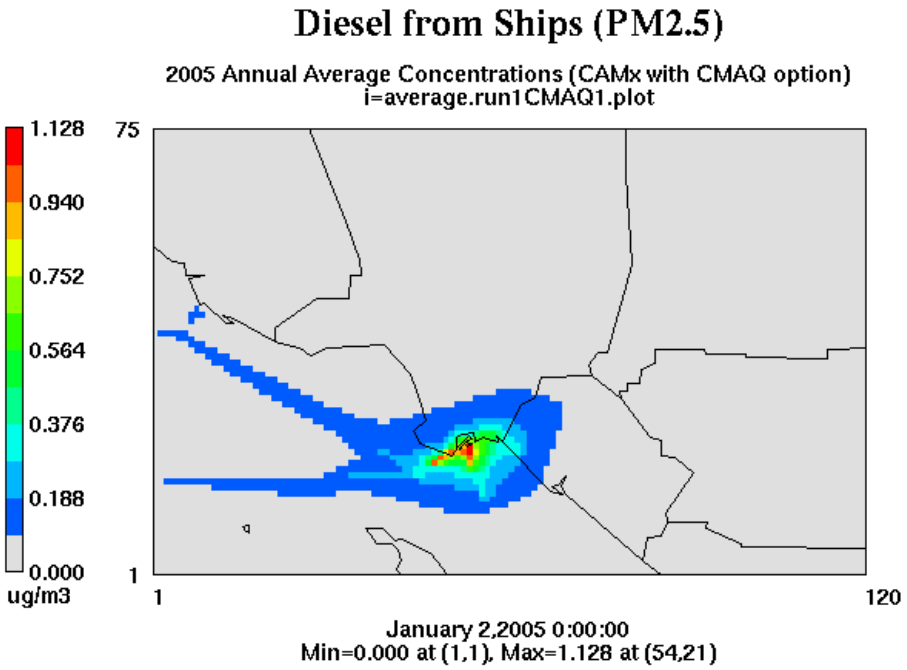

FIGURE IX-10e
CAMx simulated 2005 annual average Diesel from Ships $PM_{2.5}$

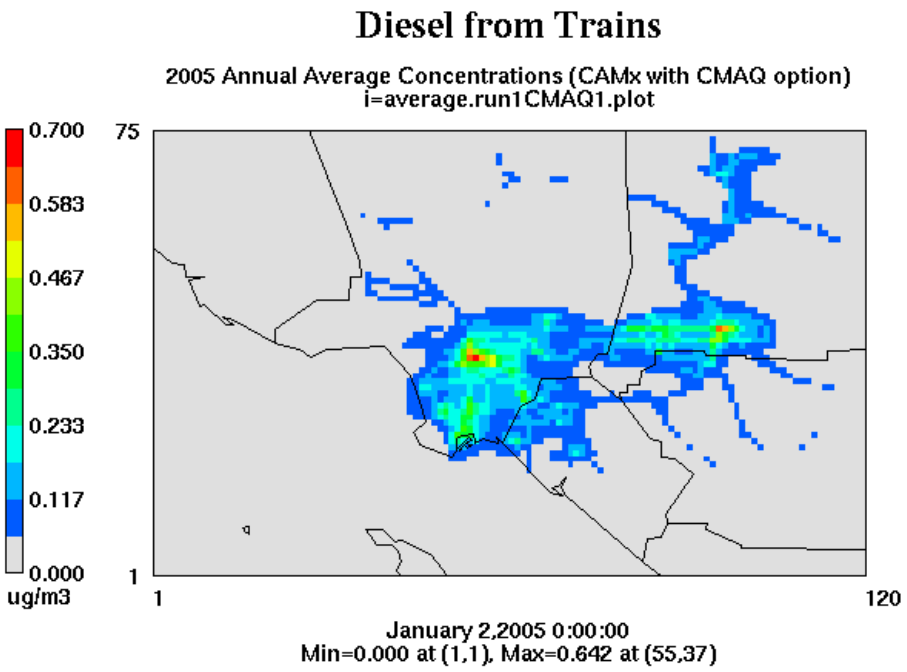

FIGURE IX-10f
CAMx simulated 2005 annual average Diesel from Trains $PM_{2.5}$

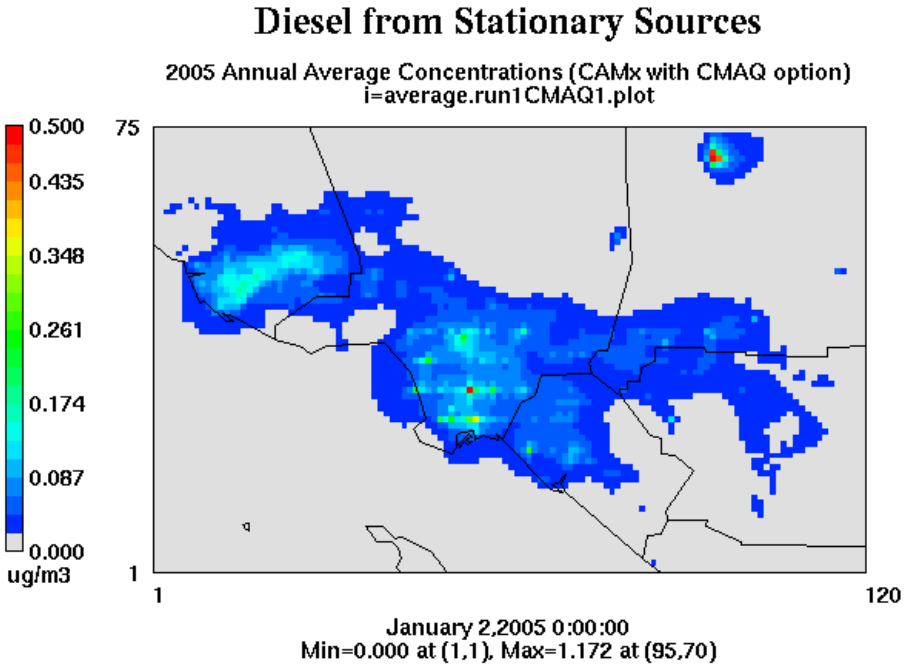

FIGURE IX-10g
CAMx simulated 2005 annual average Diesel from Stationary Sources $PM_{2.5}$

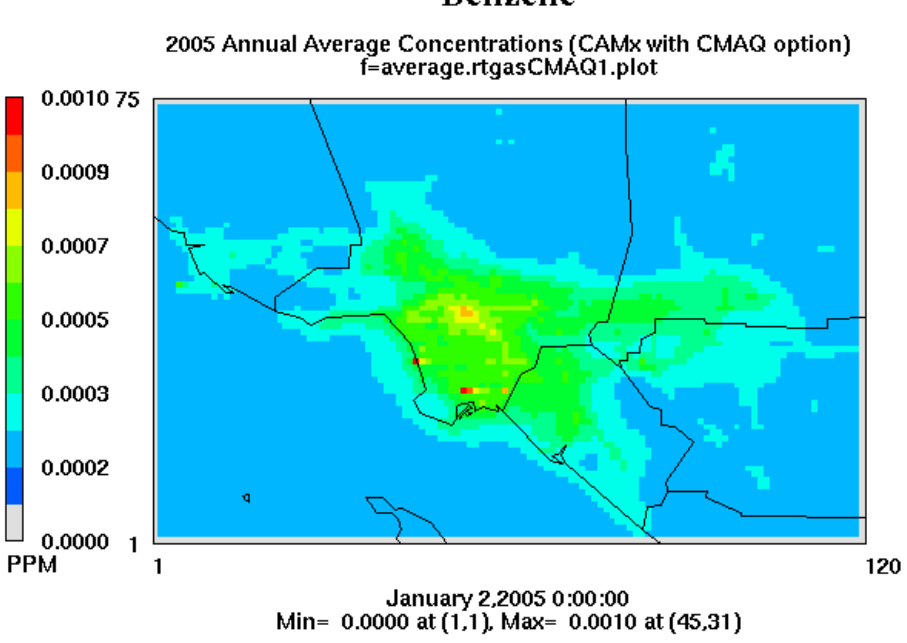

FIGURE IX-10h
CAMx simulated 2005 annual average Benzene

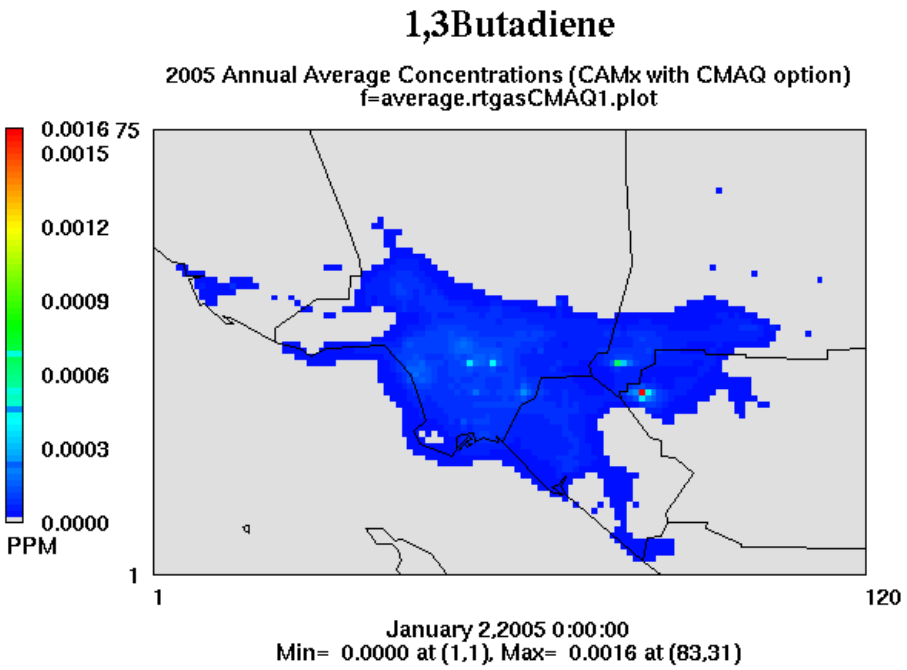

FIGURE IX-10i
CAMx simulated 2005 annual average 1,3-Butadiene

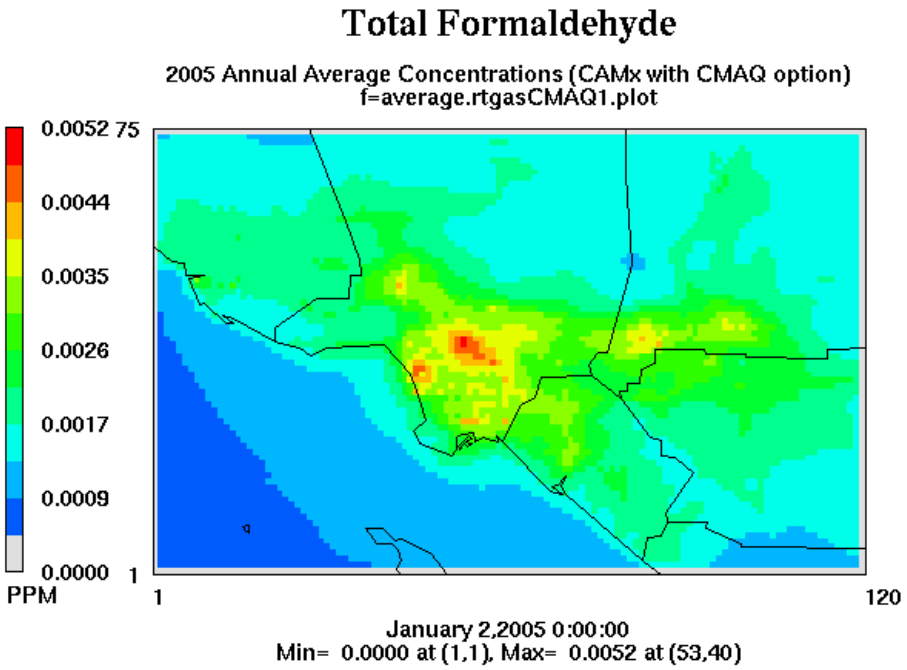

FIGURE IX-10j
CAMx simulated 2005 annual average for Total Formaldehyde

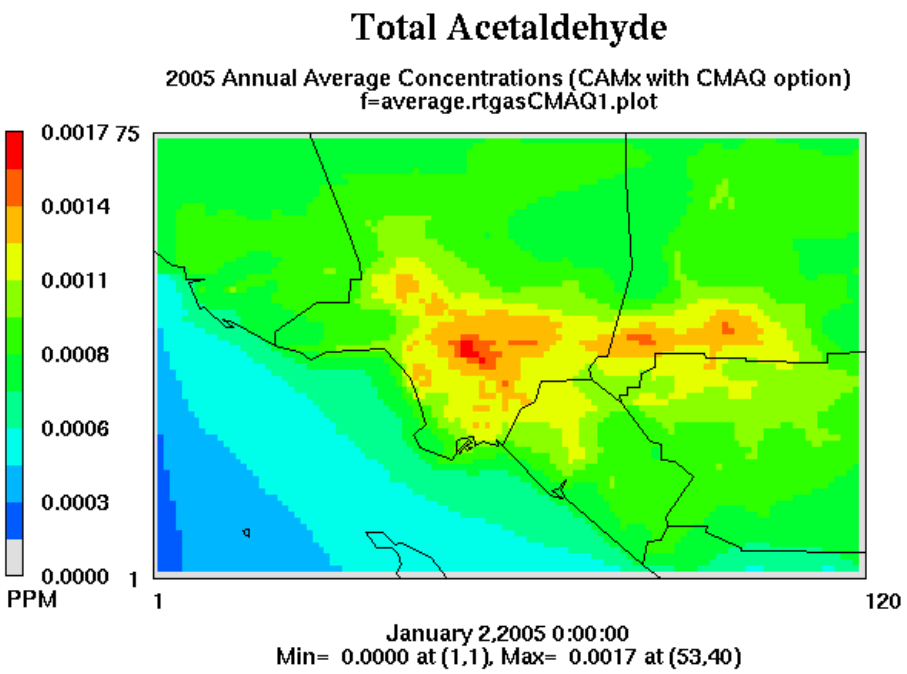

FIGURE IX-10k
CAMx simulated 2005 annual average Acetaldehyde

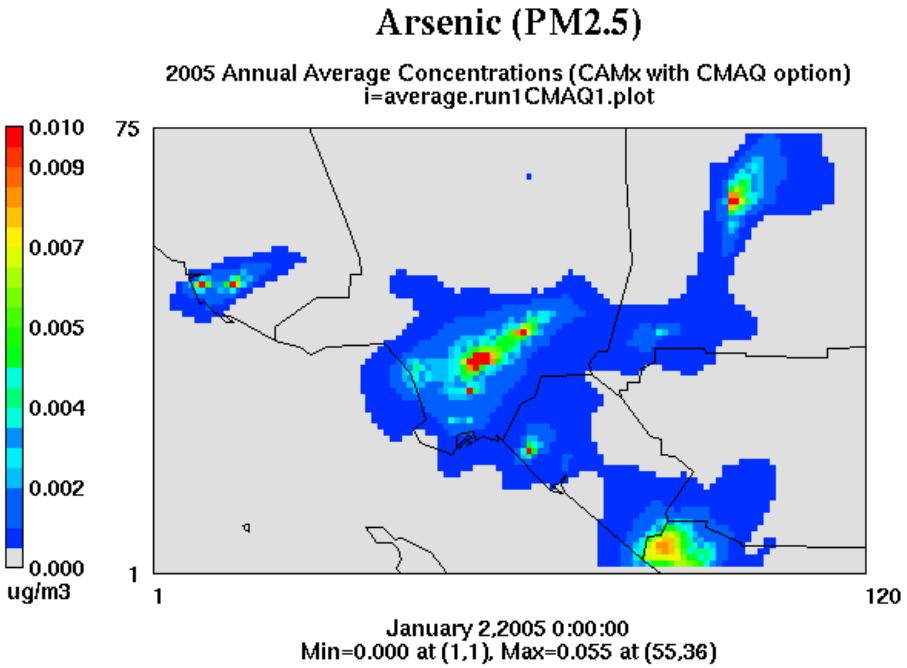

FIGURE IX-10l
CAMx simulated 2005 annual average Arsenic $PM_{2.5}$

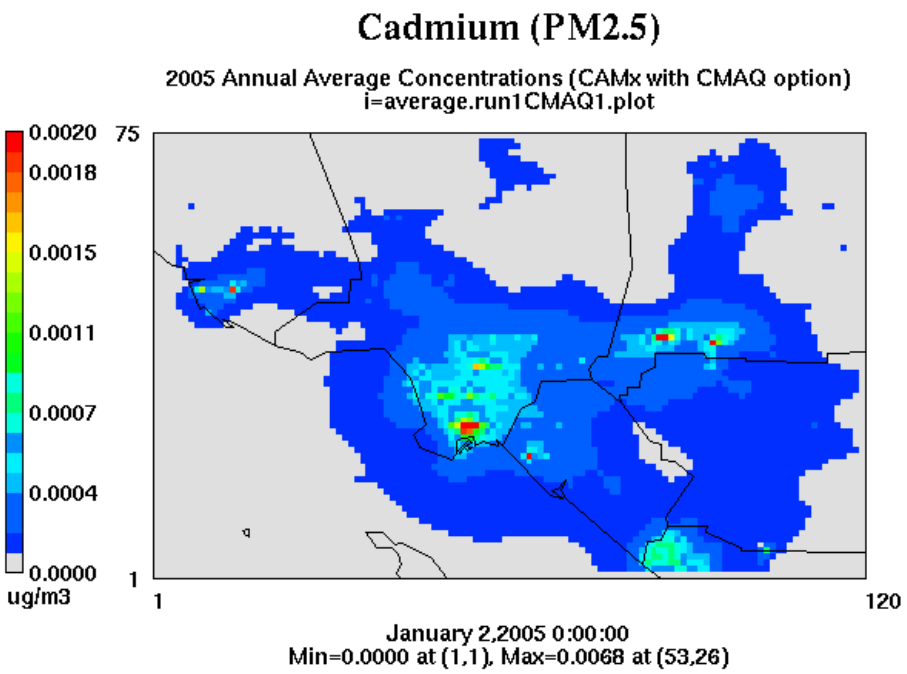

FIGURE IX-10m
CAMx simulated 2005 annual average Cadmium $PM_{2.5}$

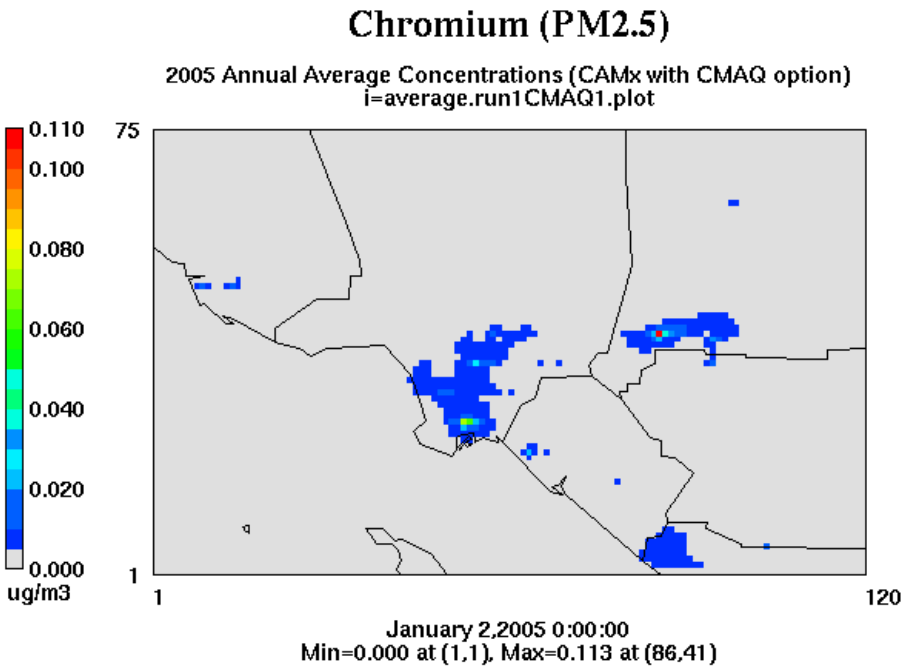

FIGURE IX-10n
CAMx simulated 2005 annual average Chromium $PM_{2.5}$

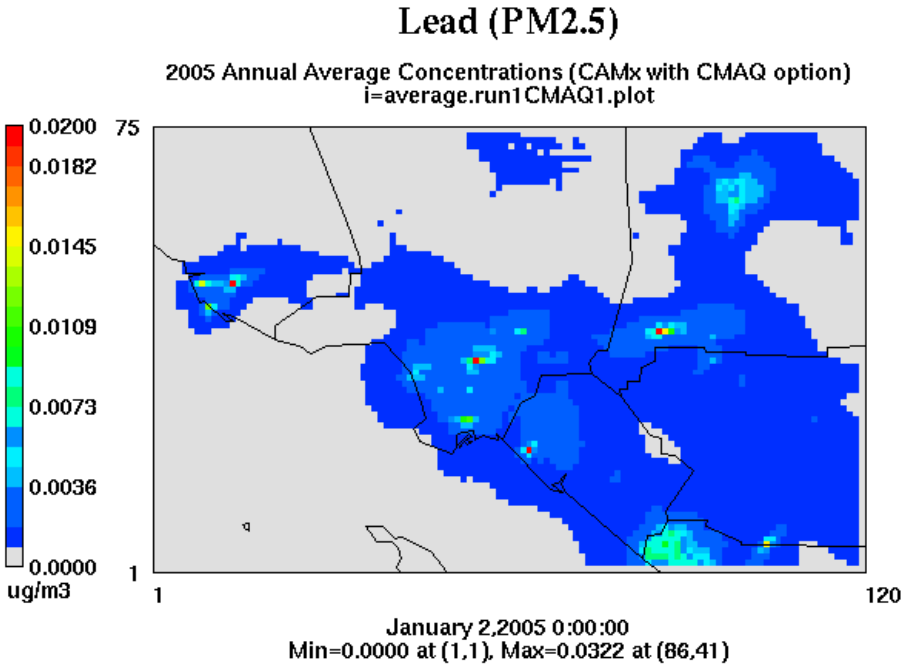

FIGURE IX-10o
CAMx simulated 2005 annual average Lead $PM_{2.5}$

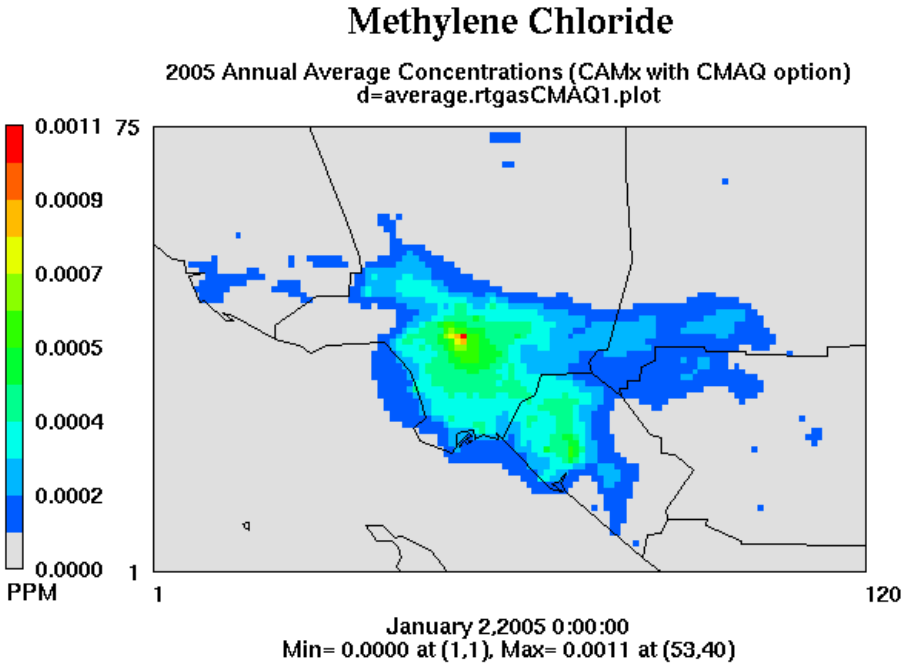

FIGURE IX-10p
CAMx simulated 2005 annual average Methylene Chloride

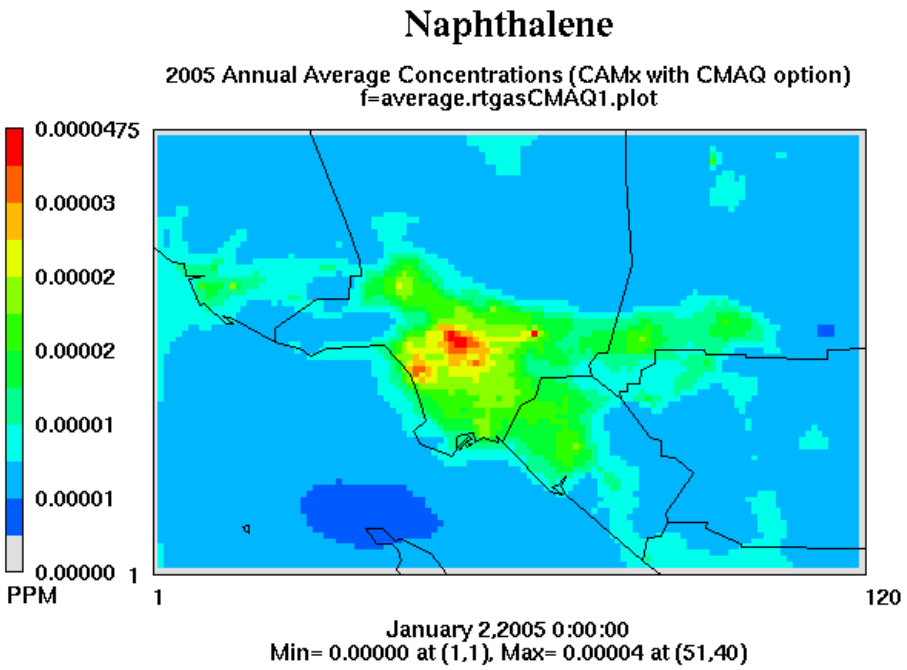

FIGURE IX-10q
CAMx simulated 2005 annual average Napthalene

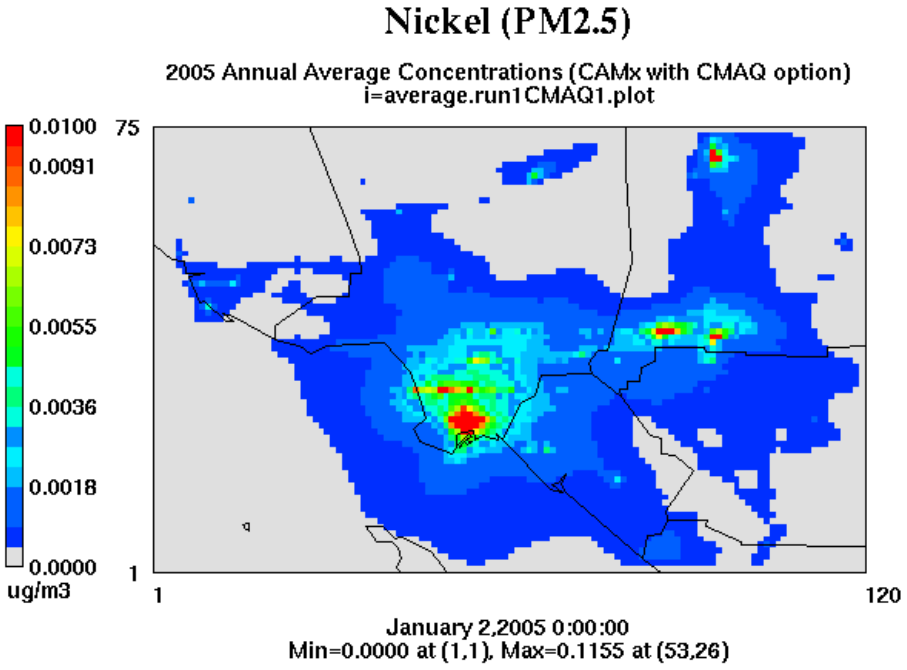

FIGURE IX-10r
CAMx simulated 2005 annual average Nickel $PM_{2.5}$

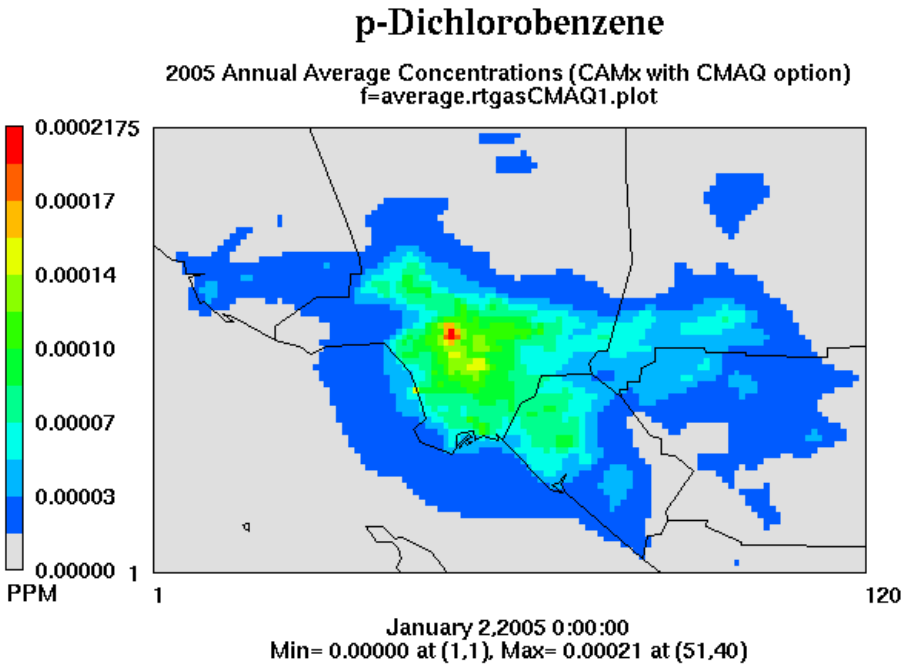

FIGURE IX-10s
CAMx simulated 2005 annual average p-Dichlorobenzene

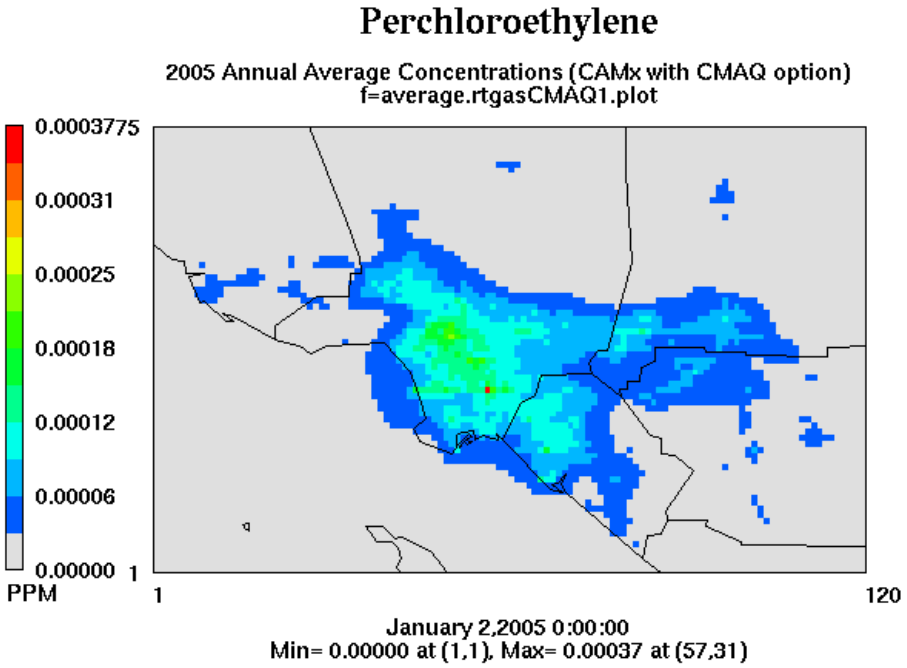

FIGURE IX-10t
CAMx simulated 2005 annual average Perchloroethylene

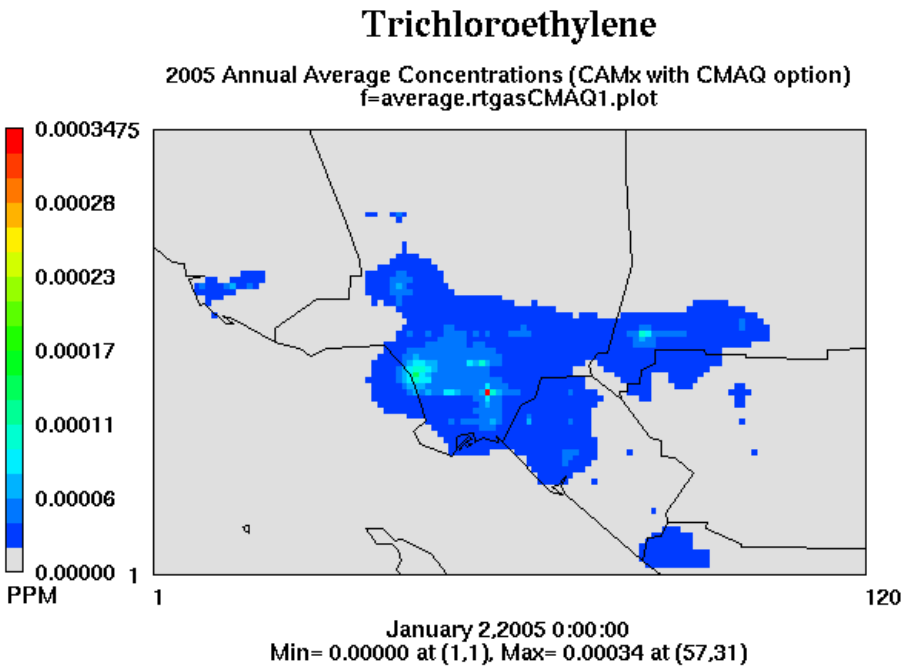

FIGURE IX-10u
CAMx simulated 2005 annual average Trichloroethylene

Estimation of Risk

Figure IX-11 depicts the cumulative distribution of risk estimated from the predicted annual average concentrations of the key toxic compounds. (Figure IX-11 is presented twice first in shaded black and white then in color). Risk is calculated for each grid cell as follows:

$$\text{Risk}_{i,j} = \Sigma \text{ Concentration}_{i,j,k} \text{ X Risk Fisk Factor}_{i,j,k}$$

Where $_{i,j}$ is the grid cell (easting, nothing) and k is the toxic compound.

The Basin average risk summed for the toxic components valued 810 additional cases of cancer in a one million person population. (The Basin average risk included all over-land cells that reside within the Basin portion of the modeling domain). The grid cell having the maximum simulated risk of 2,879 was located in the Port of Los Angeles/Long Beach. More specifically, the grids having the top 17 estimated risk values were located in adjacent cells around the port area. The cell having the highest risk outside of the port area occurred in South Los Angeles as part of a cluster of grids having high risk that extended from central Los Angeles to the southeast following Interstate-5. Other elevated areas included the eastern Basin near the communities of Colton, Fontana and San Bernardino. As with the MATES II analysis, areas projected to have higher risk followed transportation corridors including freeways, and railways. Figures IX-12a

through IX-12f depicts risk associated with diesel and its specific emissions categories. (Again, Figures IX-12a through IX12f are presented twice first in shaded black and white then in color).

The MATES III basin population weighted average risk (810 per million) is approximately 83 percent of the Basin average risk identified from the MATES II (981 per million) analysis. While it is desirable to try and compare the estimates of regional risk simulated for the Basin from MATES II to MATES III, a direct comparison would be difficult. The 17 percent reduction in Basin risk can be attributed to many factors such as updated emissions estimates and spatial allocation, dispersion and meteorological model selection. Also contributing to the uncertainty in a direct comparison is the variable weather profile between the two monitoring periods.

Table IX-7 provides the county-wide breakdown of risk to the affected population. As presented in the spatial distribution, Los Angeles County bears the greatest average risk at 912 per one million person population. Orange County has the second highest number of projected risk at 724 per one million person population. Risk in the Eastern Basin is lower. The estimated risk for San Bernardino is 631 per million, and Riverside was estimated to have the lowest population weighted risk at 410.

TABLE IX-7
County-Wide Population Weighted Risk

Region	Population	Average Risk (Per Million)
Los Angeles	9,305,726	912
Orange	2,579,794	724
Riverside	1,249,554	410
San Bernardino	1,269,919	631
SCAB	14,404,993	810

Table IX-8 provides the Basin average breakdown of risk associated with each of the key compounds simulated in the analysis. Diesel particulate ranked highest as the toxic compound contributing to the overall risk and development of excess cancers to the population. The next three highest contributors included benzene, 1,3 butadiene and formaldehyde.

Table IX-9 provides the simulated risk at each of the eight stations (evaluated in Table 4-2) for the three main toxic compounds and the remaining aggregate based on the regional modeling. Risk is calculated using the predicted concentrations of each toxic component for the specific monitoring station location (based on a distance weighted nine cell average concentration). The summary provides the comparison between simulated average risk for the eight station combine and the average risk calculated using the annual toxic compound measurements at those sites.

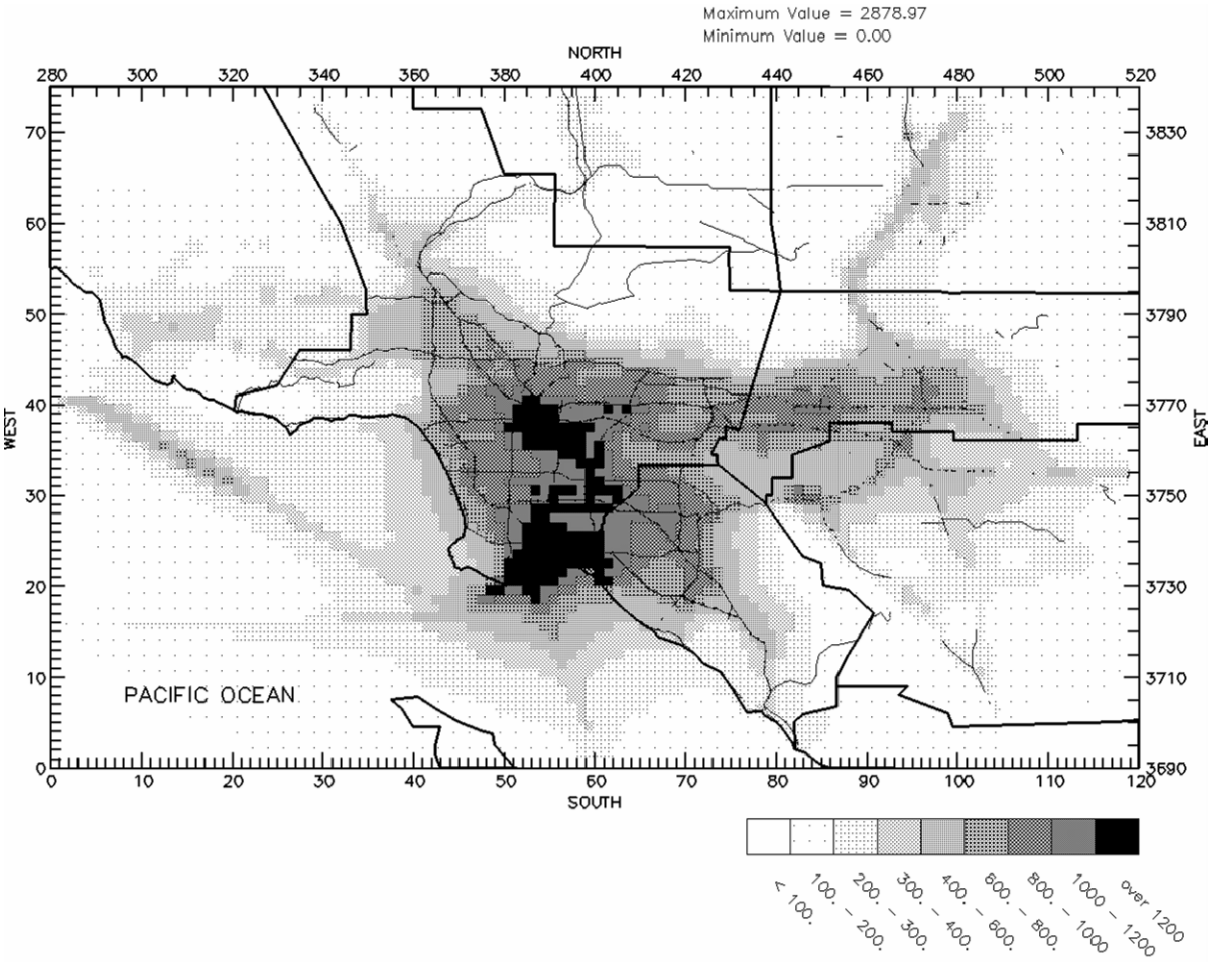

FIGURE IX-11
MATES III Simulated Total Risk

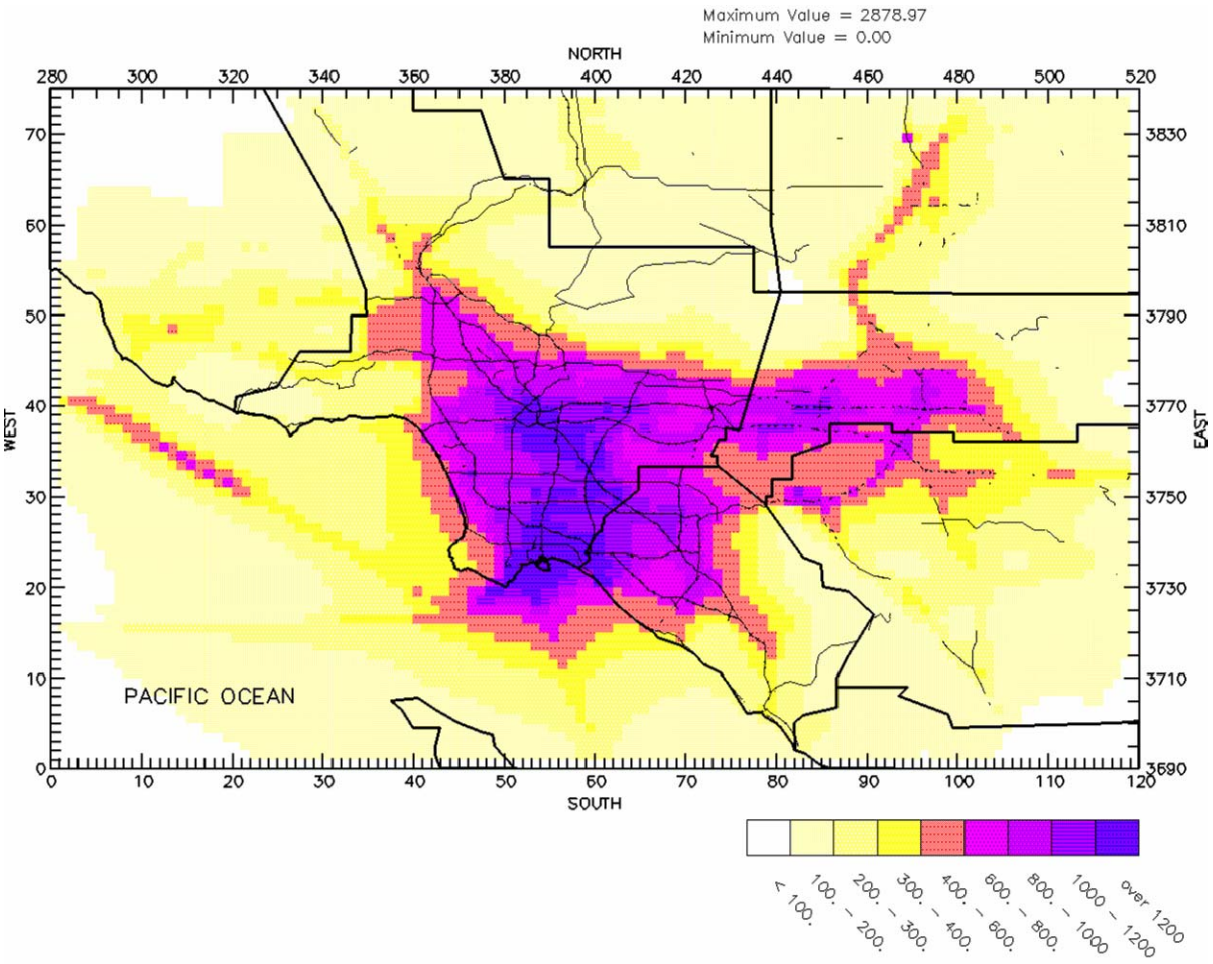

FIGURE IX-11 (Repeated)
MATES III Simulated Total Risk

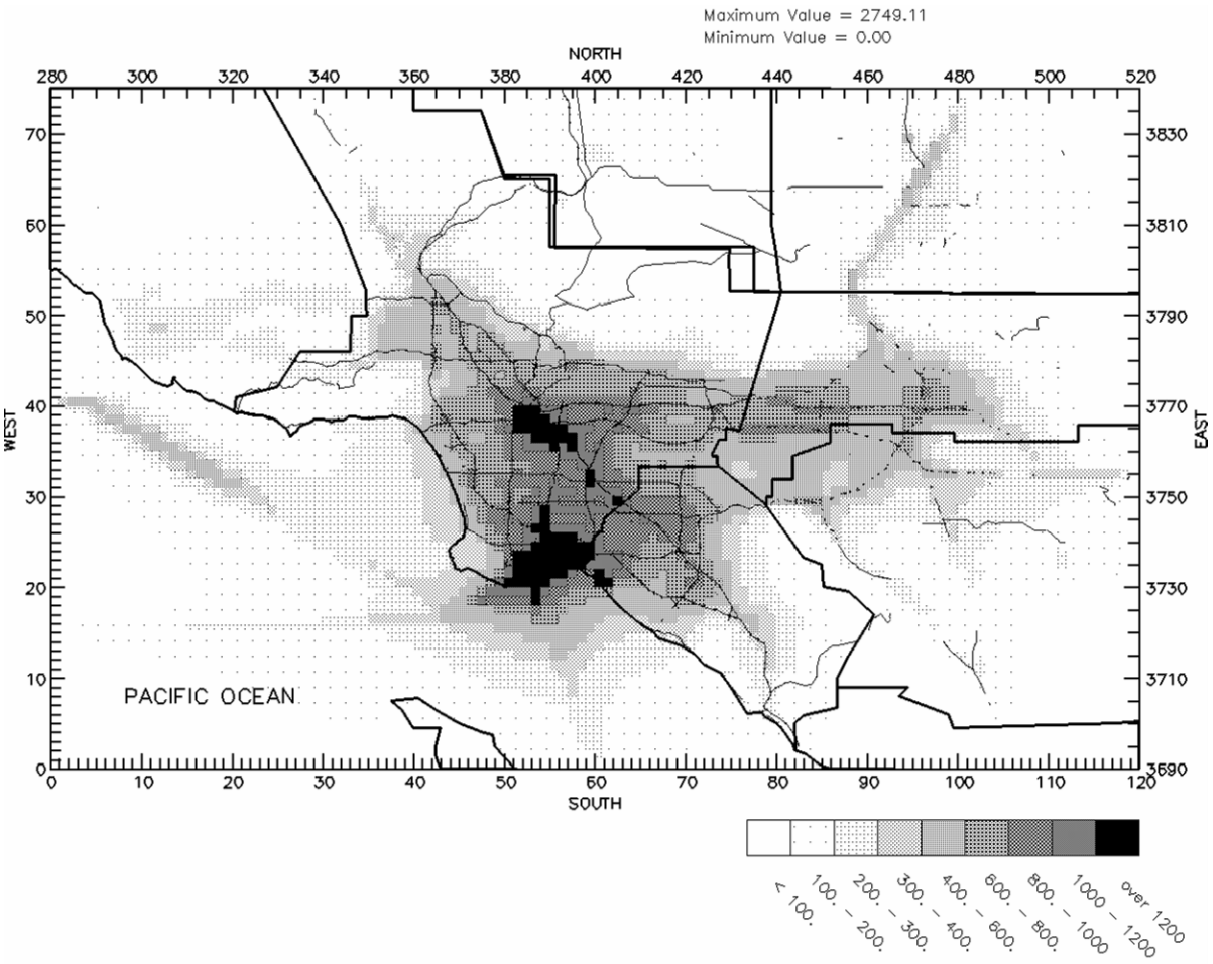

FIGURE IX-12a
MATES III Risk from Diesel

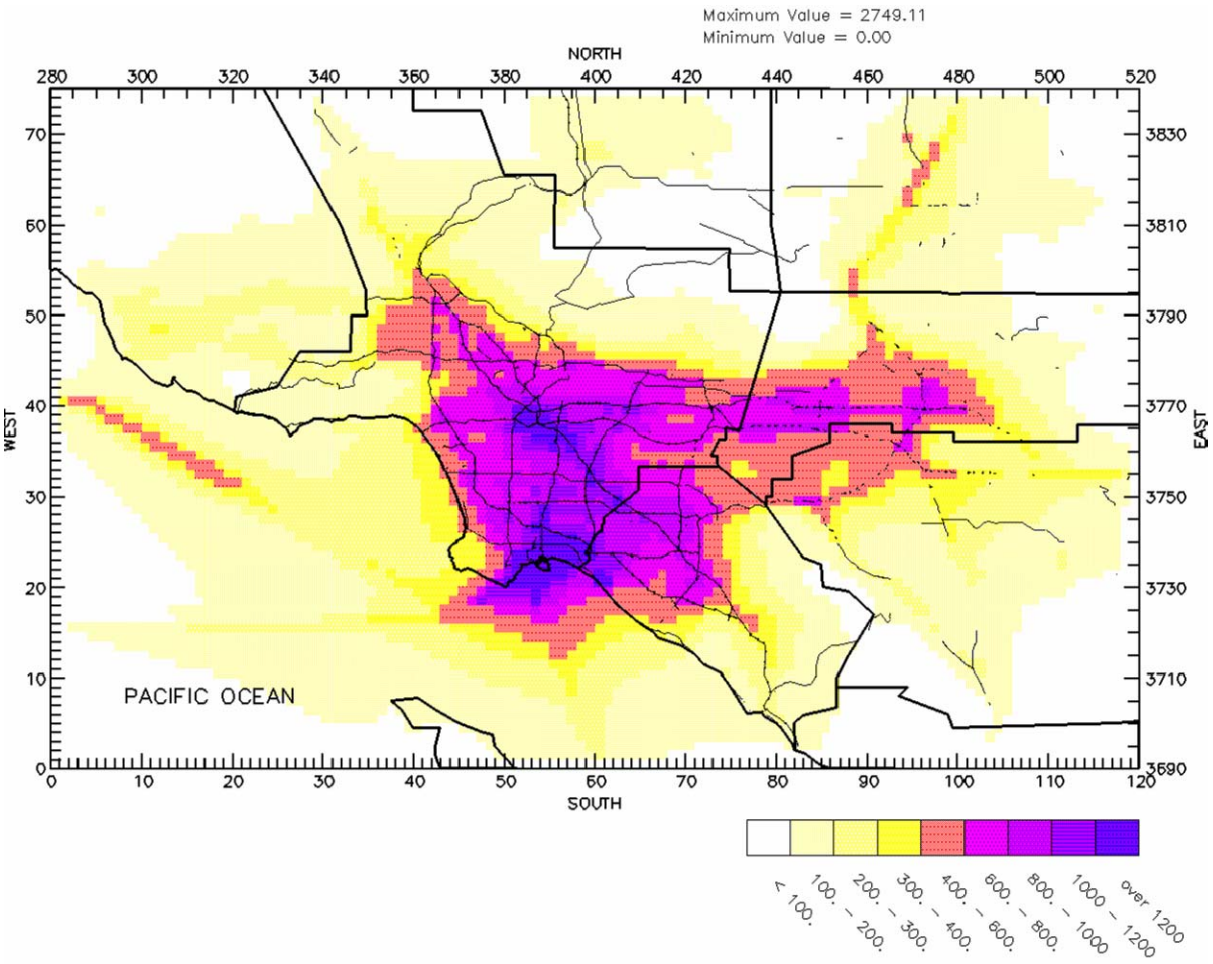

FIGURE IX-12a (Repeated)
MATES III Risk from Diesel

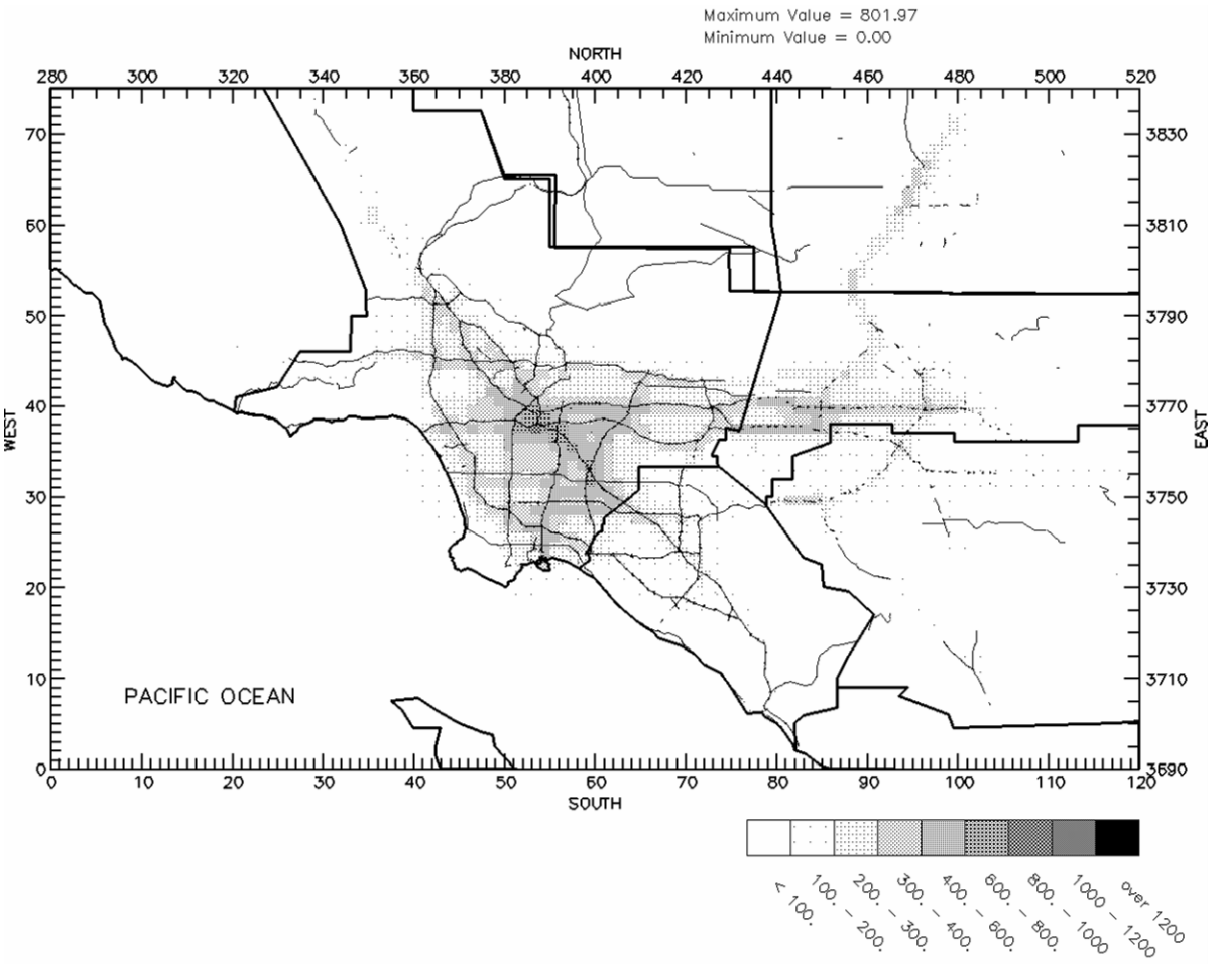

FIGURE IX-12b
MATES III Simulated Risk from On-Road Diesel

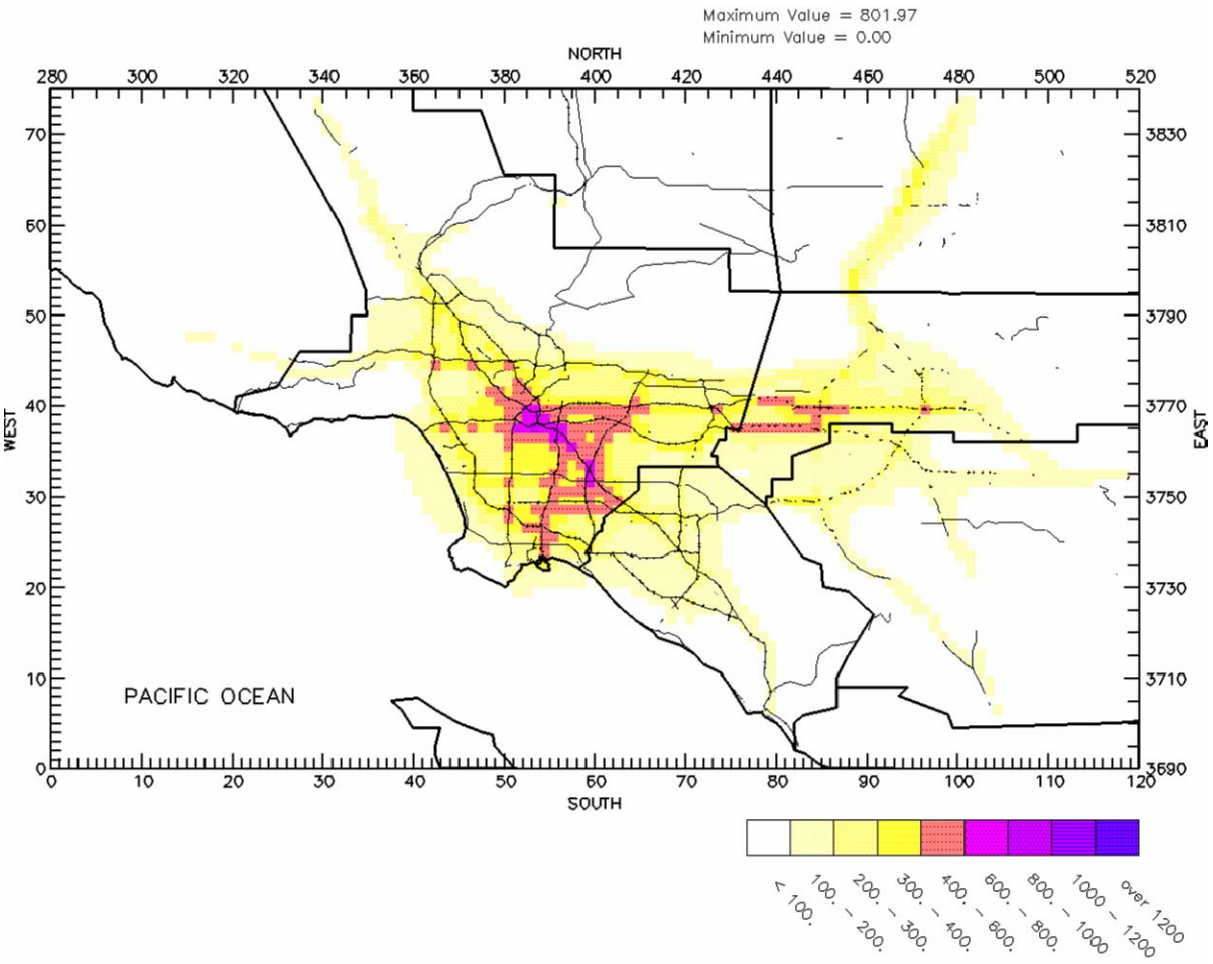

FIGURE IX-12b (Repeated)
MATES III Simulated Risk from On-Road Diesel

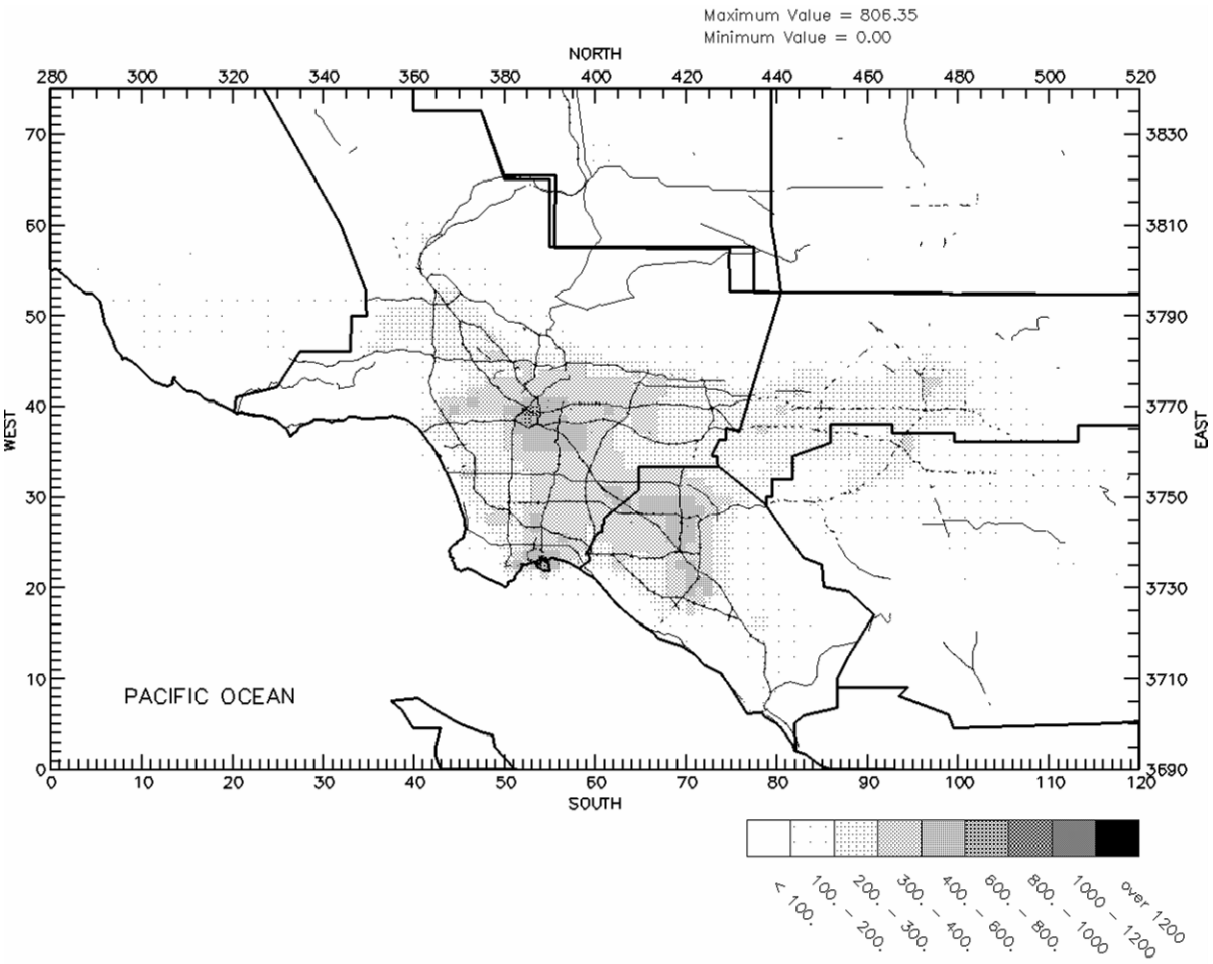

FIGURE IX-12c
MATES III Simulated Risk from Off-road Diesel
(including rail yards but excluding trains and ships)

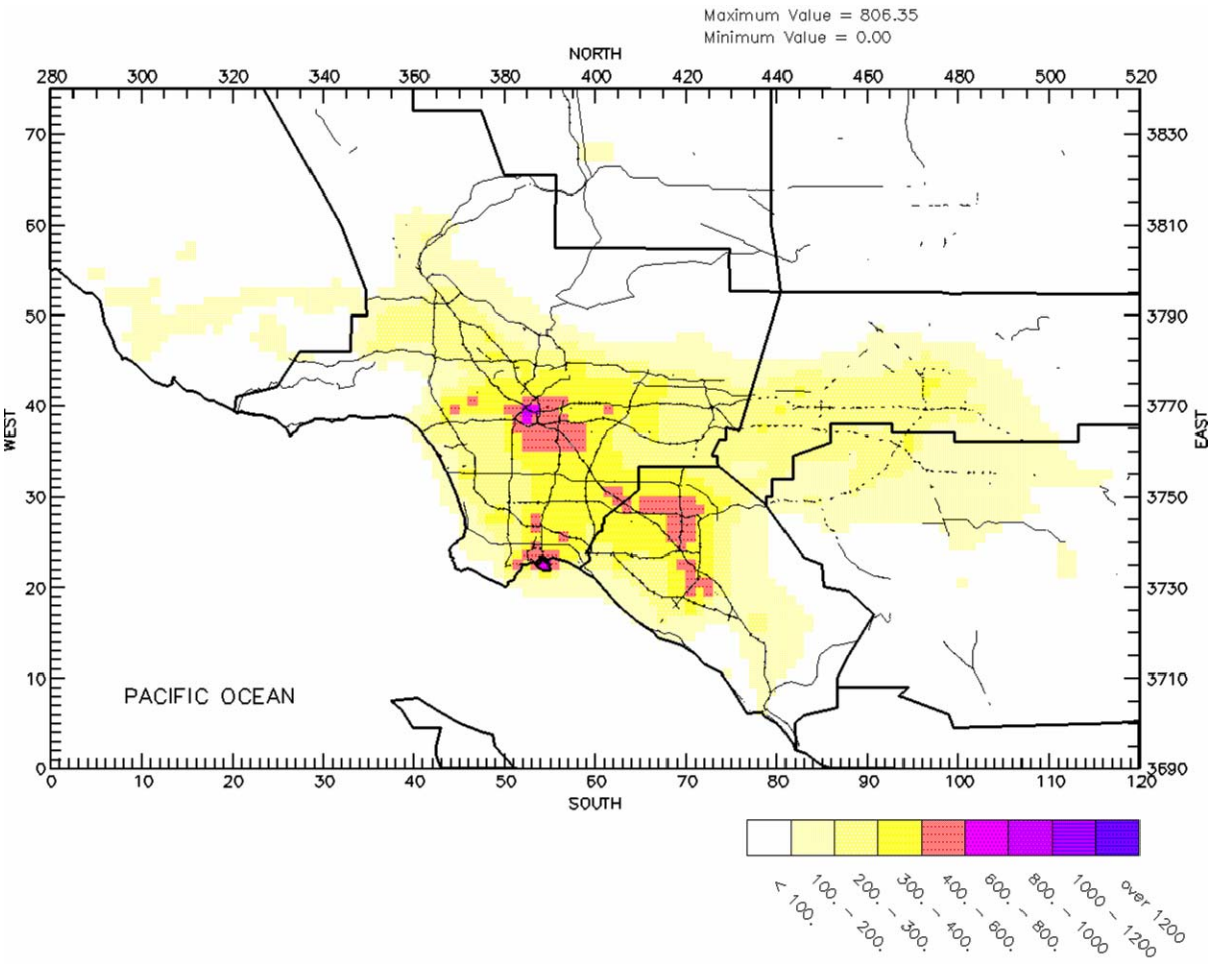

FIGURE IX-12c (Repeated)
MATES III Simulated Risk from Off-road Diesel
(including rail yards but excluding trains and ships)

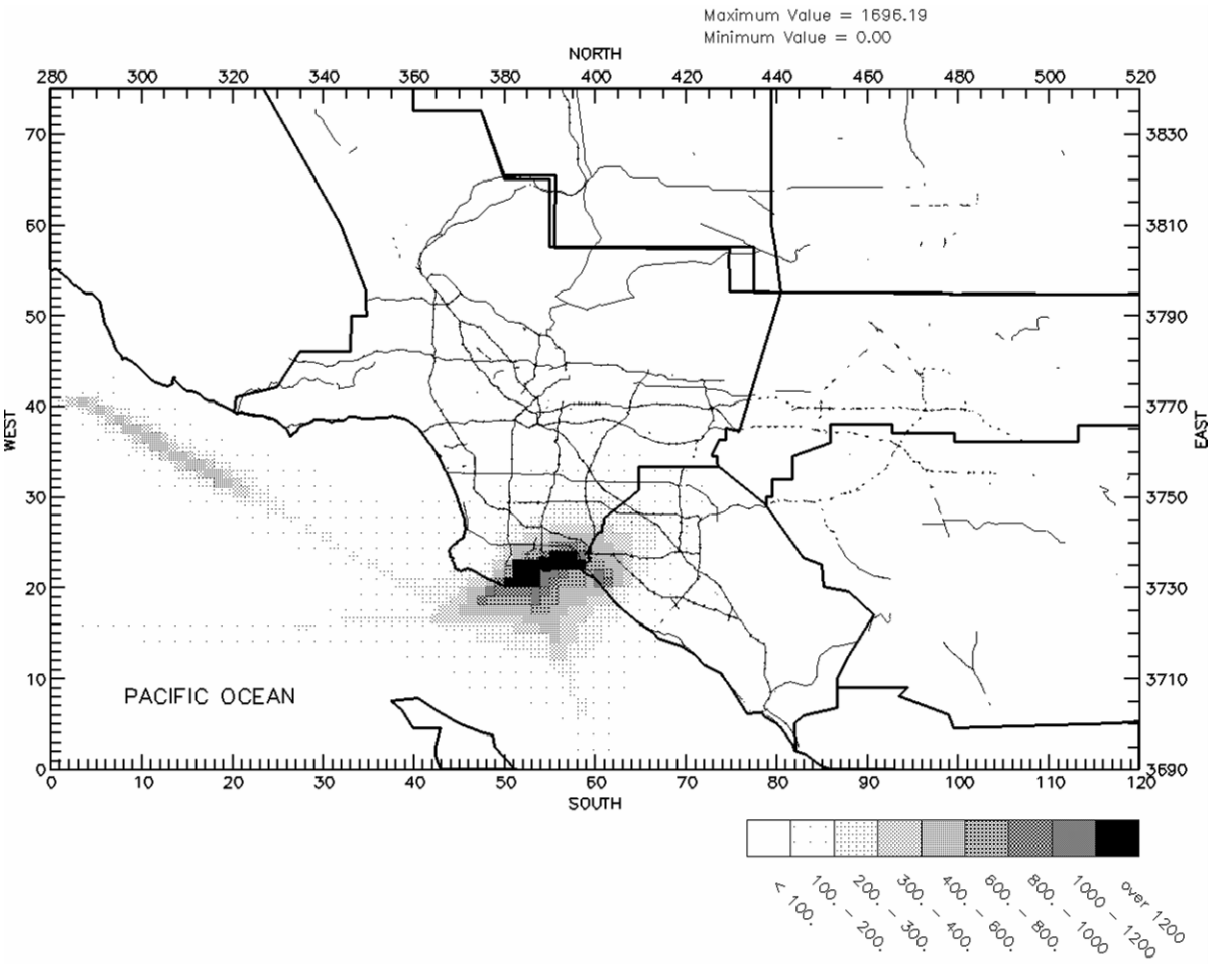

FIGURE IX-12d
MATES III Simulated Risk from Ship Diesel

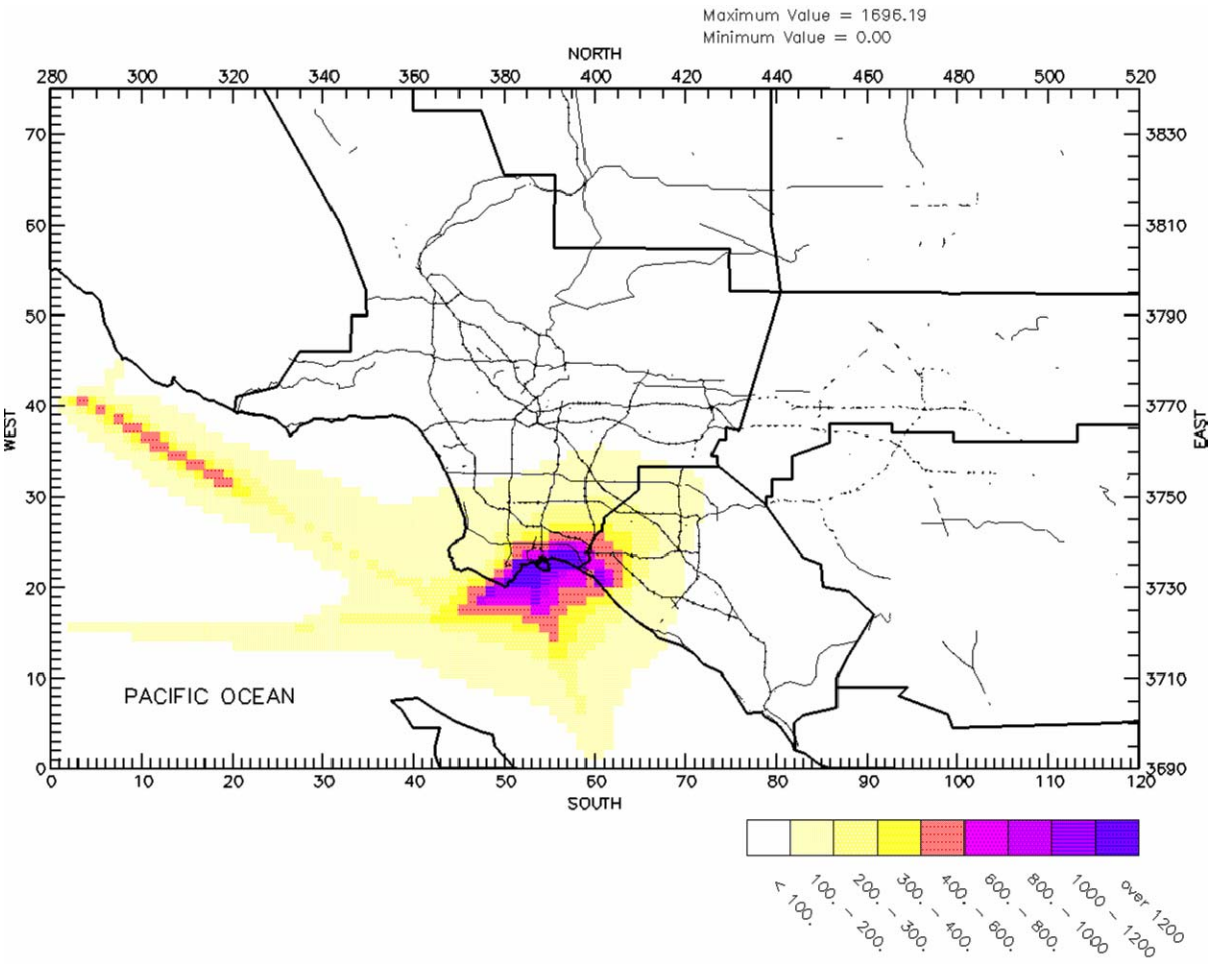

FIGURE IX-12d (Repeated)
MATES III Simulated Risk from Ship Diesel

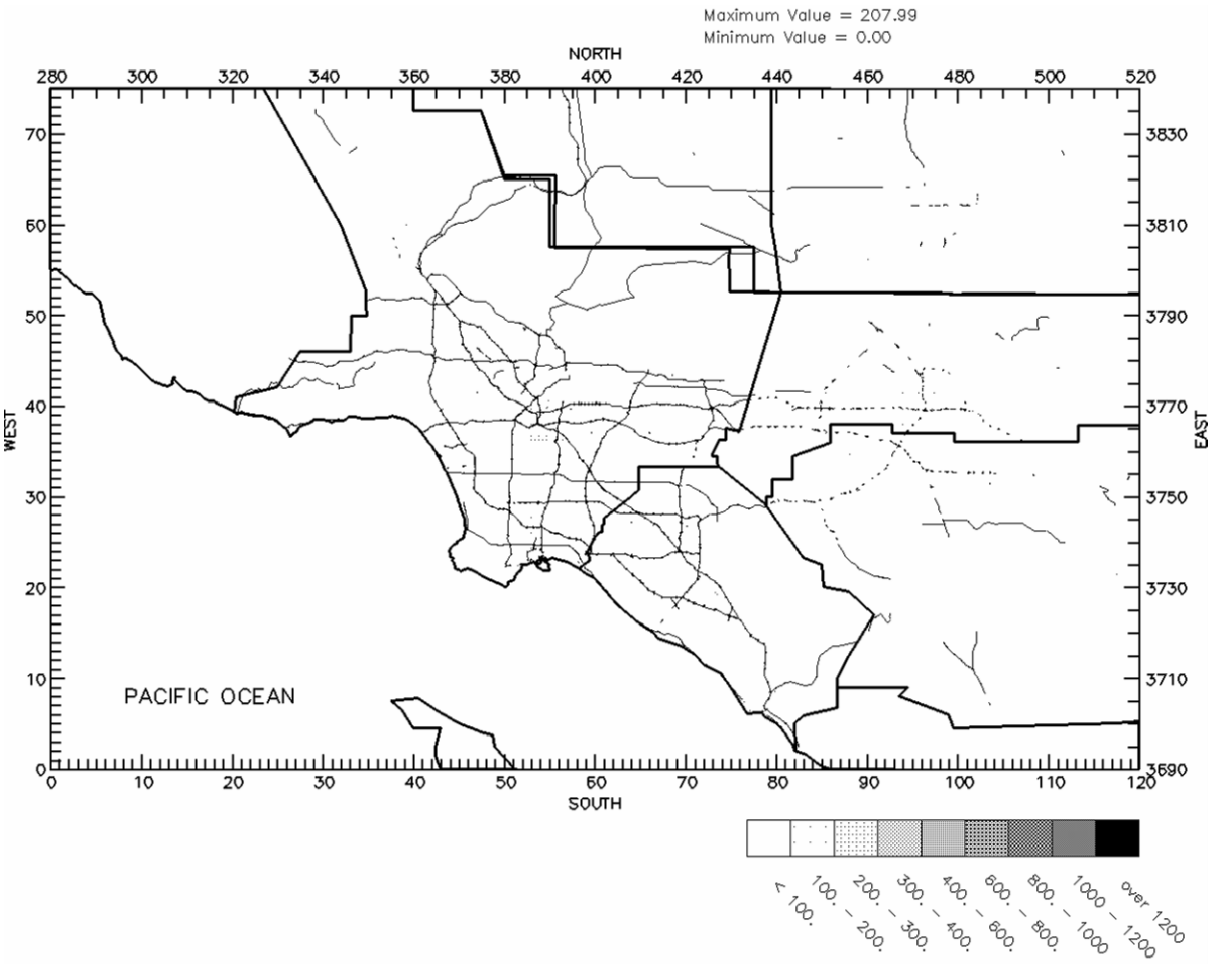

FIGURE IX-12e
MATES III Simulated Risk from Trains (Excluding Rail Yards)

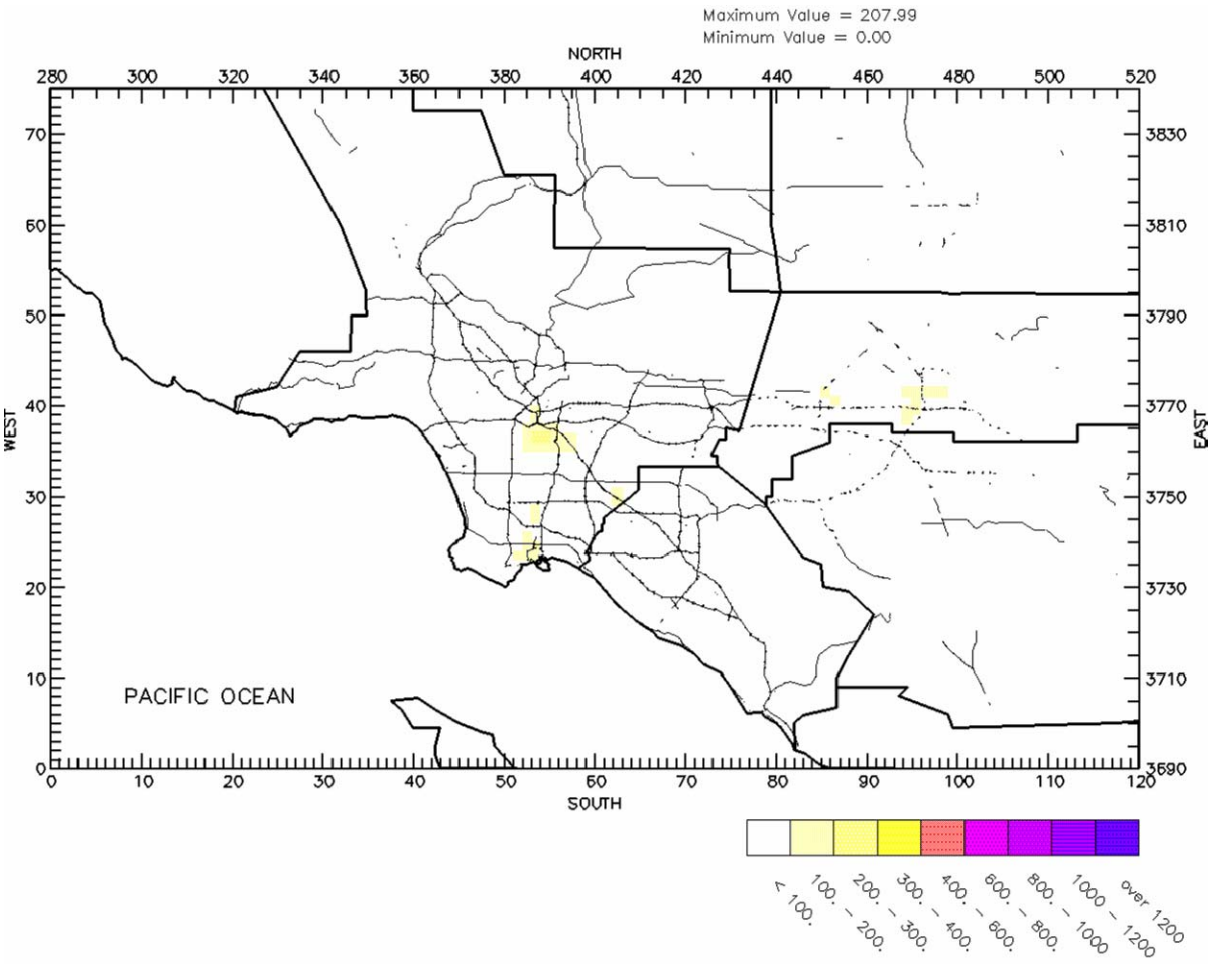

FIGURE IX-12e (Repeated)
MATES III Simulated Risk from Trains (Excluding Rail Yards)

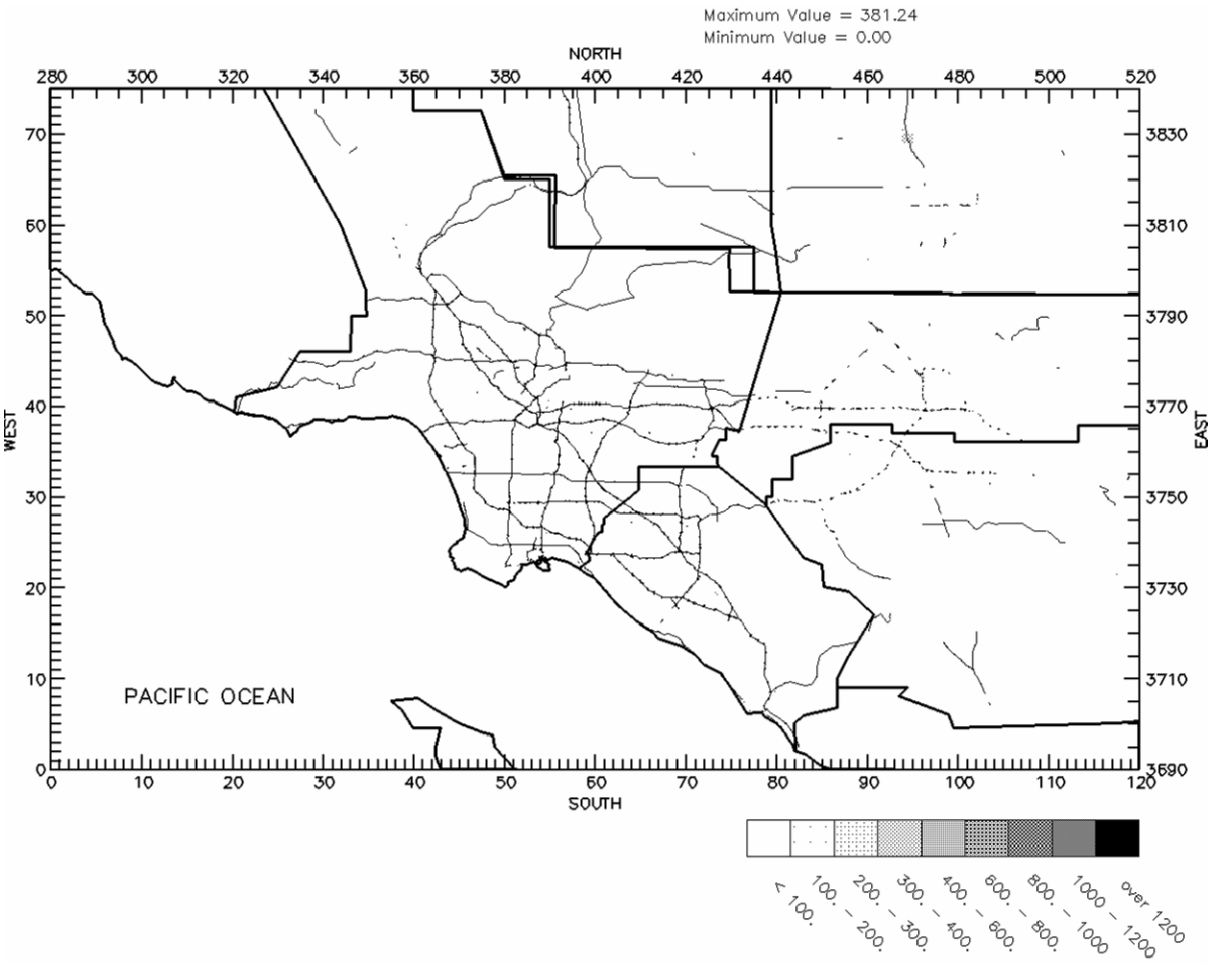

FIGURE IX-12f
MATES III Simulated Risk from Stationary Diesel

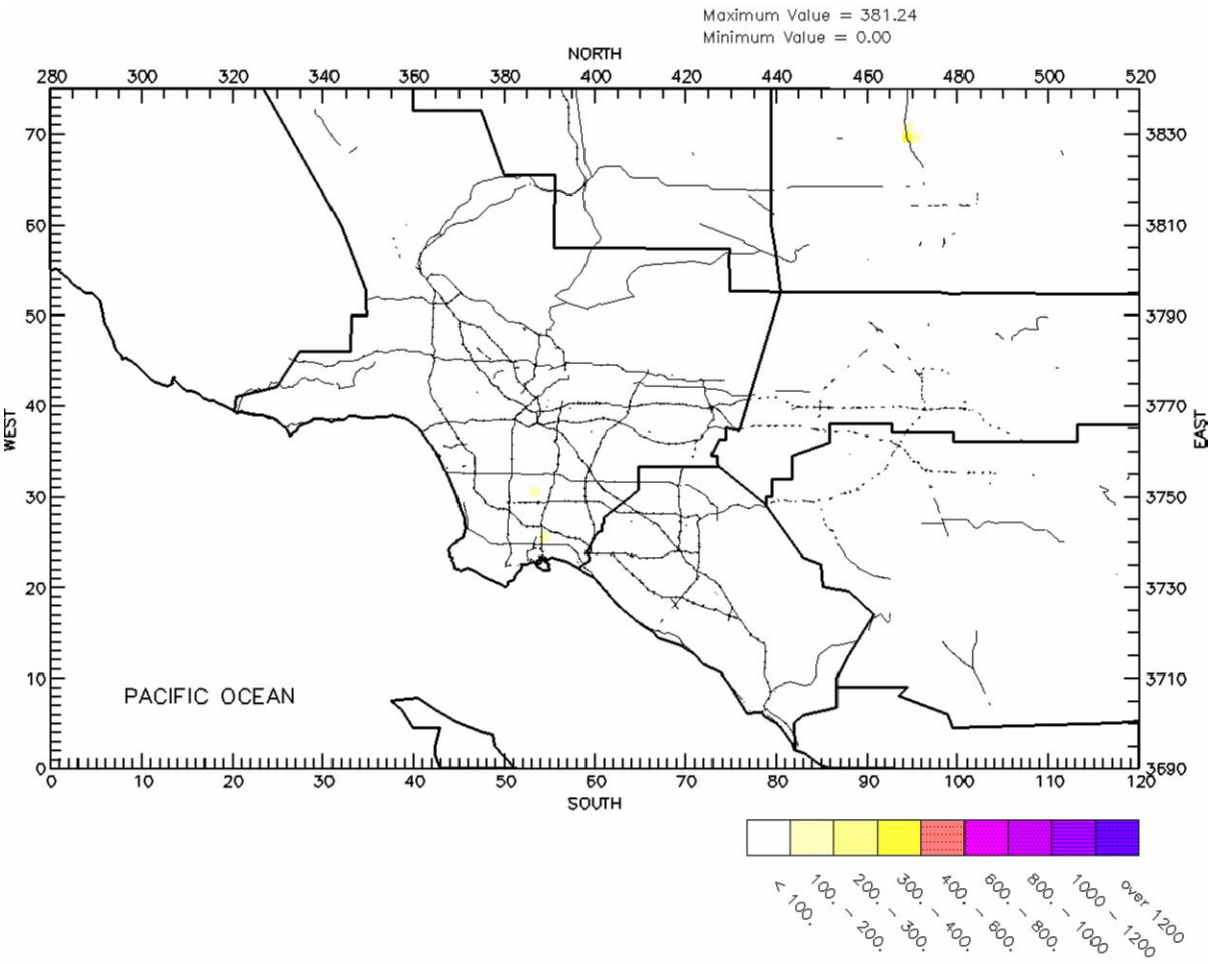

FIGURE IX-12f (Repeated)
MATES III Simulated Risk from Stationary Diesel

The highest simulated risk estimate is for Wilmington/West Long Beach, followed by Los Angeles, North Long Beach and Compton. The modeled risk at Anaheim essentially equaled the Basin population weighted risk while the remaining stations had risk lower than the Basin average. Taken as an eight station average, the modeled risk (956 in a million) is higher than the Basin average population weighted risk (810). However, the simulated risk is lower than the risk calculated from the measured toxic compound concentrations and the estimates of diesel concentrations. The eight-station average risk based on measurement data exceeded the simulated risk eight-station average by approximately 11 percent (1,059 in a million) for the inventory-based diesel concentration and by 23 percent (1,175 in a million) based on the CMB method. The non-diesel- related portion (especially considering benzene and 1,3-butadiene) of risk for all three averages is essentially equivalent confirming that model performance was recreating ambient toxic compound concentrations with acceptable accuracy.

TABLE IX-8
Basinwide Risk from Individual Toxic Compounds

Toxic Compound	Basinwide Risk (per million)	Percent Contribution
Diesel	681.62	84.1
Benzene	43.46	5.4
1,3 Butadiene	27.7	3.4
Primary Formaldehyde	11.37	1.4
Secondary Formaldehyde	11.16	1.4
Hexavalent Chromium 6	8.26	1.0
Arsenic	7.97	1.0
p-Dichlorobenzene	5.02	0.6
Secondary Acetaldehyde	4.02	0.5
Perchloroethylene	3.67	0.5
Cadmium	2.4	0.3
Primary Acetaldehyde	1.69	0.2
Methylene Chloride	0.99	0.1
Nickel	0.9	0.1
Trichloroethylene	0.33	< 0.1
Lead	0.09	< .01

TABLE IX-9
Comparison of the 2005 Network Averaged Modeled Risk to Measured Risk
at the Eight –MATES III Sites

Location	Benzene	Butadiene	Other	Diesel	Total
Anaheim	14	13	42	813	882
Burbank	14	11	38	582	645
Compton	16	24	60	873	973
Fontana	12	8	76	585	681
Long Beach	17	16	51	1158	1242
Los Angeles	20	21	60	1167	1268
Rubidoux	11	8	37	489	545
Wilmington/West Long Beach	18	12	71	1314	1415
Average Modeled	15	14	54	873	956
Average Measured (EC2.5 * 1.72 for Diesel)	17	16	80	946	1059
Average Measured (CMB)	17	16	80	1004 - 1120	1117 - 1233

Evaluation

The population weighted average Basin risk (810 per million) simulated from the MATES III data for 2005 was estimated to be 17 percent lower than the similar average population weighted risk (981) estimated for the 1998-99 MATES II analysis. The areas of the Basin having maximum risk continued to be the Ports of Los Angeles and Long Beach with a secondary maximum occurring in an area starting in central Los Angeles and extending towards southeastern Los Angeles. The overall improvement in average risk and the impact observed in the metropolitan area is confirmed by both the monitoring data and modeling results.

MATES III Compared to MATES II: Apples to Oranges?

While it is desire able to directly compare the estimations of risk from MATES III to MATES II, it is difficult to fully assess the impact caused by the major shift in emissions, modeling platforms and chemistry modules. Table IX-10 provides a summary comparison of the key model considerations between the MATES II and MATES III modeling analyses. The following discussion addresses those differences in the studies to provide a better framework for discussion.

Table IX-10

Summary Comparison of Key Modeling Considerations between MATES III and MATES II

Parameter	MATES III	MATES II
Model Platform / Chemistry	CAMx / RTRAC	UAM/TOX
Meteorology Model /Layers	MM5 Prognostic / 7 layers	Diagnostic Wind Model / 5 layers
Vertical Diffusion	Blackadar PBL to determine grid-layer specific vertical diffusivity	Hourly grid specified mixing height
Boundary Conditions	Segmented Boundary: low over water & higher over land	Constant Boundary
On-Road Truck Emissions	CalTrans/SCAG Truck Model	Used passenger vehicle pattern
Shipping Emissions Stack Height	Emissions spread through layers 1 and 2	Emissions released in layer 1 (variable size)
Emissions Inventory	2007 AQMP: 2005 Projection with updated AB2588 source profiles	1998 Projection with AB2588 Source Profiles
Mobile Emissions	EMFAC2007	EMFAC7G

Model Platform

Of the changes made to the modeling platform, moving to CAMx which relies on MM5 model derived vertical diffusion characterization appears to have increased vertical dispersion throughout the modeling domain compared with UAM. The net impact from enhanced vertical dispersion is lower ground level concentrations. This is supported by comparative analyses conducted for the 2003 AQMP. Episodic 1-hour average peak concentrations of ozone were predicted to be 18 percent higher using the UAM dispersion platform and objective meteorological input data than for CAMx run with a MM5 based meteorological field. While the comparison is for an episodic period, it is reasonable to assume that for an annual simulation the same tendency should be observed (UAM TOX over predicting).

It is important to restate that the upgraded modeling and chemistry platforms provided similar results to those presented in the 2007 AQMP $PM_{2.5}$ attainment demonstration for elemental carbon values (with only Wilmington/West Long Beach displayed a higher predicated bias).

Meteorological Models

Meteorological field development was significantly different between the two analyses. The MATES III meteorological fields were generated using MM5 with minor adjustments due to data assimilation. The resulting data fields were more mass consistent and exhibited enhanced characterization of vertical dispersion. The MATES II meteorological fields were constructed using the Diagnostic Wind Model (DWM) and a set of meteorological fields generated from objective analysis. As previously discussed, past evaluations conducted for the 2003 AQMP indicated that the UAM platform tended to predict higher peak pollutant concentrations than CAMx for the same meteorology but using different methods of model input preparation. Applying this observation to the current analysis can explain a portion of the difference in population weighted risk between MATES II and MATES III.

A sensitivity simulation using UAM TOX and a modified version of the meteorological fields used in the CAMx simulation and the MATES III emissions data to attempt to normalized the prediction between modeling platforms. The simulation was conducted for the particulate species and the results indicated that the difference in predicted diesel concentration between the two models was within a few percent.

Vertical Dispersion

Analysis of the MM5 generated MATES III vertical dispersion field indicated deeper mixing over the central Basin compared with the field used in MATES II. This would act to increase dispersion, lower ground level toxic concentrations and lessen the risk over densely populated areas. MATES II vertical dispersion was based on objective analysis and extrapolation of daily vertical temperature profiles and may have understated the extent of diurnal mixing in the modeling domain by limiting vertical mixing to the height

of the inversion base. Conversely, MM5 estimated mixing over the immediate coast and over water areas tends to be nominally shallower than observation based calculations and may lead to a slight increase in predicted risk but to a less densely populated portion of the modeling domain.

Boundary Conditions and Modeling Domain

MATES II used a smaller modeling domain than MATES III and a spatially uniform higher set of boundary concentrations for the model simulations. On the western boundary (seaward) of the modeling domain, the MATES II diesel boundary concentration was over 10 times higher than that used in MATES III. The MATES II boundary was essentially set within the shipping lanes and may have contributed to higher predicted diesel concentrations along the coast. The MATES III boundary was extended 30 km to the west to approximate a cleaner boundary.

Weather Considerations

General assessments of the meteorological profile suggest that the two monitoring periods were comparable in dispersion potential but not identical. At the issuance of this draft document, staff is evaluating the potential to recreate the 1998-1999 meteorological fields using MM5. The new meteorological fields would be used in CAMx to compare the impact of different years weather would have on exposure given the same (2005) emissions. The fields will be generated provided the needed initialization data can be retrieved from the National Weather Service or one of its affiliated agencies.

Spatial Allocation of Emissions

The spatial distribution of diesel emissions between MATES II and MATES III is significant. The MATES II inventory placed a large percentage of the diesel emissions at the port area and offshore along the shipping lanes. The emissions from trucks were also spread more uniformly throughout the Basin following the travel pattern identified for gasoline vehicles. Diesel emissions remained high in the port areas for 2005 MATES III modeling inventory. However, refinements in truck travel routes and better characterization of rail emissions resulted in a pattern shift that is more clustered near the freeways in the coastal plain and metropolitan areas.

Shipping Stack Heights

The impact of spreading the shipping emissions through the first two modeling layers was reflected in a redistribution of risk away from the coast, inland. Considering the whole Basin, population weighted risk did not change significantly.

A sensitivity simulation was conducted where shipping diesel emissions were restricted to be emitted solely in the first model layer. The results of the sensitivity analysis were compared the MATES III simulation where shipping emissions were distributed through the first two fixed layers in the modeling domain. Averaged over a broad area including

the near coastal water areas of the shipping lanes (including Santa Monica Bay and San Pedro Channel) and the extreme southwestern communities of Los Angeles County (Redondo Beach, Torrance, Long Beach, San Pedro, Wilmington/West Long Beach and the Ports of Los Angeles and Long Beach) the stack height adjustment resulted in a 14 percent improvement in risk. In the immediate vicinity of the Ports of Los Angeles and Long Beach risk improved by 24 percent due to the spreading of emissions through the lowest two levels in the modeling domain. In contrast, risk to areas downwind of the ports and immediate coast increased resulting in only a nominal (less than 0.5 percent) reduction in ground level Basin average diesel particulate concentrations.

Emissions Inventories and Mobile Emissions Models

Significant differences exist between the MATES II 1998-1999 and MATES III 2005 emissions inventories. A comprehensive discussion of the emissions inventories and model is provided in Chapter 3 of the main document. Diesel emissions estimated for 2005 in the MATES III inventory are approximately 22 percent higher than for the 1998-1999 MATES II inventory. Back-casts of the 1998 diesel inventory made from the current 2002 inventory are approximately 3 percent higher in diesel emissions than the MATES III 2005 diesel level. Using the 2007 AQMP inventory back-cast methodology, the percentage reduction in diesel mass emissions between 1998 and 2005 is approximately 5 percent. However, emissions reductions of benzene (36 percent), 1,3-butadiene (31 percent), arsenic (20 percent) and hexvalent chromium (85 percent) contribute greatly to the overall reduction in 2005 simulated risk.

1998-99 Vs. 2005: CAMx Simulations Using MATES III and Back-cast of Equivalent MATES II Emissions

To build upon the emissions inventory evaluation, simulations were conducted using the back-casted 1998-1999 inventory and the 2005 meteorology and 2005 background conditions. The results of the analysis are summarized in Table IX-11. The total risk reduction from the change in emissions (1998-1999 to 2005) is approximately 12 percent. The risk associated with diesel contributes greatest to the overall risk reduction. Moreover, contributions from butadiene, benzene and hexavelant chromium contribute more than 50 percent to the total. Had the boundary concentrations been adjusted upward, it is likely that the gap between the observed 17 percent improvement and the 12 improvement based on the simulated emissions reduction would be closed further. Simulations using MM5 simulations of 1998-1999 meteorology and adjusted boundary conditions may explain a majority of the remaining uncertainty between the MATES II and MATES III analyses.

Summary

Taken collectively, 12 percent of the 17 percent observed improvement since 1998-99 is likely attributable to emissions reductions. Each element of the remaining analysis contributes to the improvement in average Basin risk estimated for 2005. From a technical perspective, the MATES III modeling analysis represented the state-of-science

application of regional modeling tools and chemistry applied to an updated set of meteorological and emissions input data. The model output compared well with the 2007 AQMP $PM_{2.5}$ attainment demonstration and should equally be considered state-of-the–science. The average simulated Basin risk based on the 2005 MATES III data is lower than the comparable average risk estimated for the 1998 MATES II analysis.

Reference

WRAP, (2007), Western Regional Air Partnership, Technical Support System, Emissions Method, Offshore Emissions, http://vista.cira.colostate.edu/TSS/Results/Emissions.aspx.

TABLE IX-11

Comparison of CAMx Simulated Risk for MATES III and the MATES III Modeling Platform Using 1998-1999 Back-cast Emissions

Compound	CAMx Simulated with Back-casted 1998-99 Emissions*	MATES III 2005 CAMx Simulation	Delta Risk Reduction	Percentage of Total Risk Reduction
Diesel	720.5	681.2	39.3	36.2
Benzene	65.2	43.4	21.8	20.1
1,3Butadiene	48.9	27.7	21.2	19.5
Chrome-6	20.2	8.3	11.9	11
Formaldehyde	28.1	22.5	5.6	5.2
Perchloroethylene	7	3.7	3.3	3
Arsenic	10.9	8	2.9	2.7
Acetaldehyde	6.7	5.7	1	0.9
Cadmium	3.2	2.4	0.8	0.7
Methylene Chloride	1.6	1	0.6	0.6
Nickel	1.4	0.9	0.5	0.5
Trichloroethylene	0.5	0.3	0.2	0.2
Lead	0.1	0.1	0	0
p-Dichlorobenzene	4.7	5.2	-0.5	-0.5
All	919	810.4	108.6	100

* Using the same 2005 meteorological data as MATES III